CIVIL ENGINEERING

JUNE 1958

THE MAGAZINE OF ENGINEERED CONSTRUCTION

Bridge over Fox River — one of 219 structures using prestressed concrete girders on Illinois Toll Highway. See article by Van Buren and Zollman.

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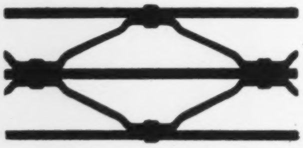

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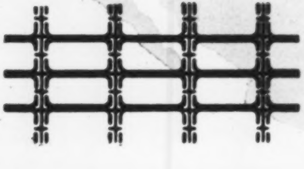

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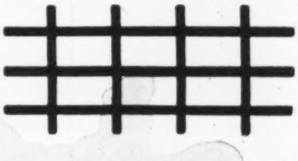

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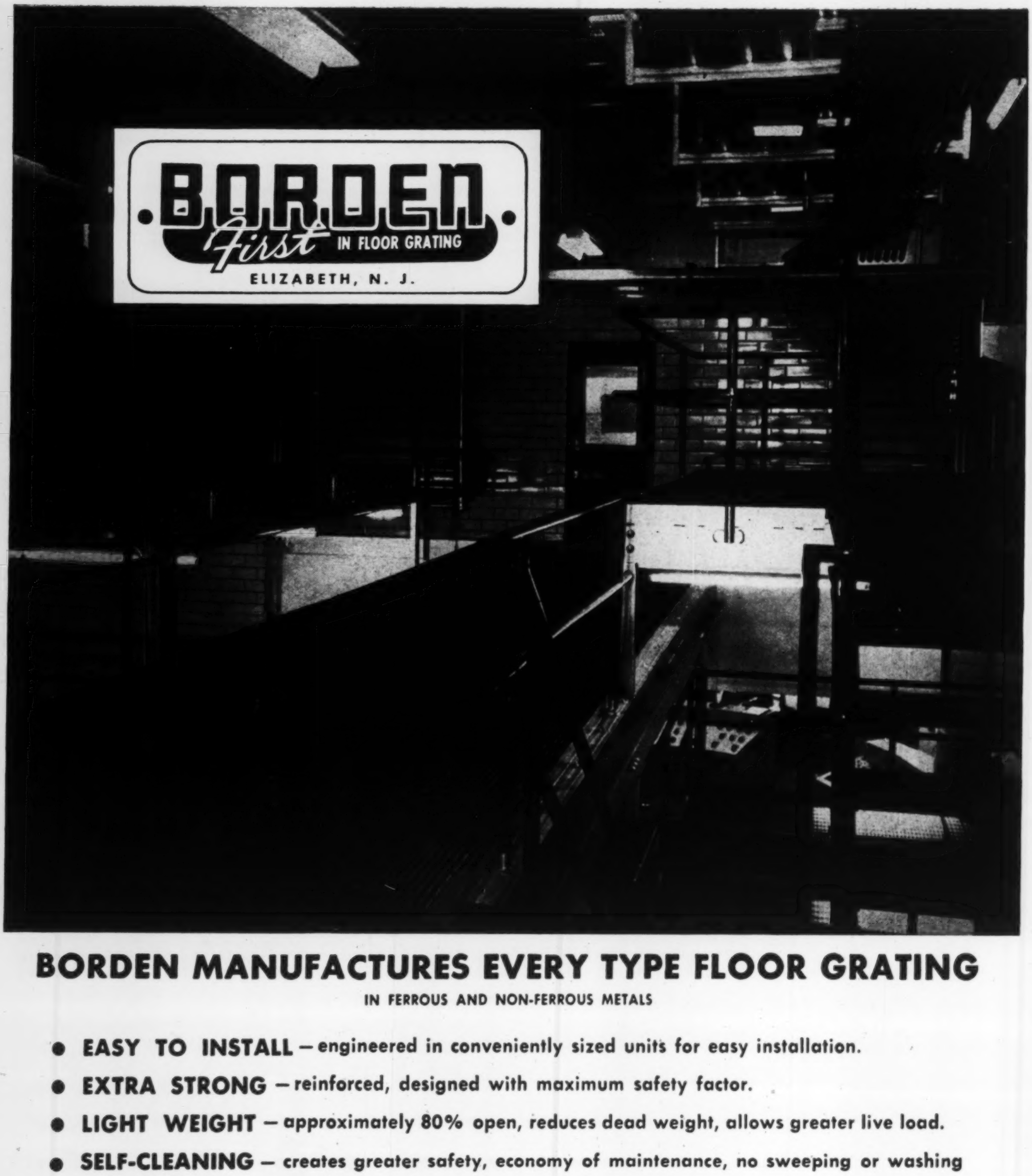

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VOL. 28 • NO. 6

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THRU TRAFFIC KEEP RIGHT

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Steel is the ideal bridge-building material. It has a long history of proven dependability, it's a familiar material that designers and erectors like to work with, and it's *versatile*.

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Because of the obvious advantages of steel bridge construction, it is fortunate U. S. Steel had the foresight years ago to plan greatly expanded facilities to manufacture structural shapes and plates. These facilities are now in production, and more are on the way to meet the swelling demand of the Interstate Highway Program.

In view of these growing facilities, you can confidently design bridges with steel—the material you know the best, the material that offers the most—knowing it will be available when needed.

So remember—no matter what kind of bridge you design, *you can count on steel.*

The bridge illustrated above was designed by the Texas Highway Department.
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Extended working season . . . better protection against sudden showers.

Faster set permits early rolling of coarse aggregate mixes, and fast opening of pavement to traffic.

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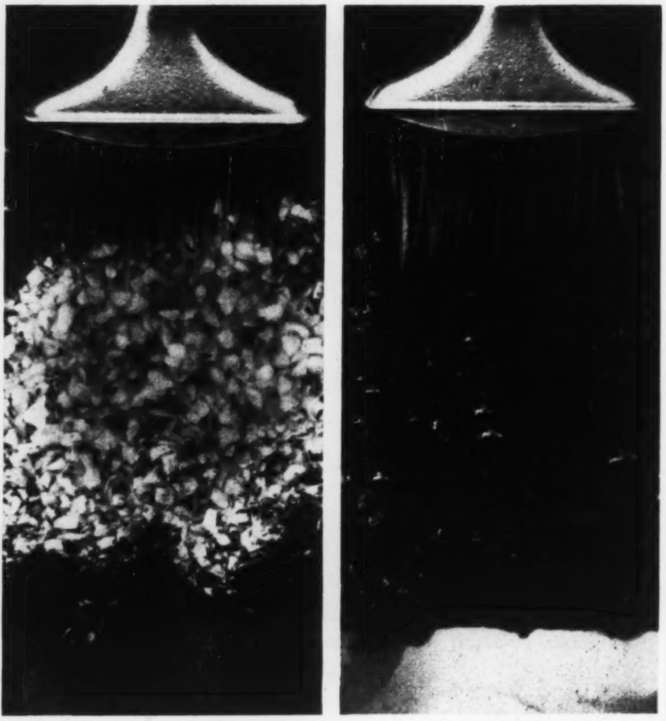
CATIONIC Bitumuls is available from certain of our strategically located plants. Our engineers are ready to discuss projects which you may wish to set up for trials of this new product with specific types of aggregate.



Proof . . . the superior coating and holding properties of new **CATIONIC** Bitumuls are clearly demonstrated in this test. Note the almost-complete wash-out of the conventional road binder (left); while **CATIONIC** Bitumuls (right) firmly holds the crystal-silica chips used for these test mix samples.

American Bitumuls & Asphalt Company

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Mobile, Ala.	San Juan 23, P. R.	Tucson, Ariz.
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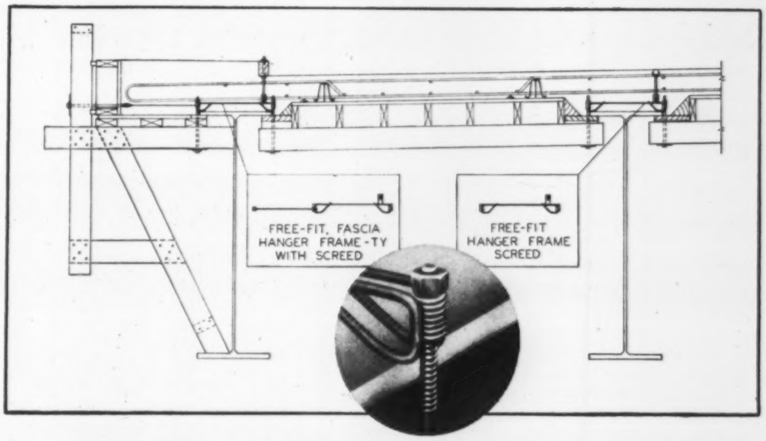
Support of these slab forms was quickly and easily accomplished from above with the Richmond Free Fit Hanger Frame-Ty. (Bridge above Ardsley over Saw Mill River Parkway—part of New York State Thruway construction; Raylin Construction Corp. and The Lynn Corporation, general contractors.)

Study of Slab Form Support Shows Savings with Richmond System


FREE-FIT, FASCIA HANGER FRAME-TY WITH SCREED
FREE-FIT HANGER FRAME SCREED

By what standards do contractors measure the effectiveness of flat slab form support methods? Which support systems are proving most helpful?

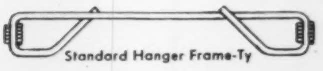
A survey brought out the following facts: *experienced contractors measure the effectiveness of flat slab form support systems in terms of three things: the degree of speed, safety and economy which they bring to a job.*

Loose wire is no longer used extensively because it meets none of the above three requirements. The use of wire beam saddles also is becoming less common. Although prefabricated to size, they are non-adjustable, and there is no positive means of tightening against the steel to prevent leakage of concrete.

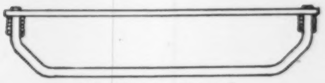
Posting or "horses" are still used but this method is comparable to bracing wall forms. Prefabrication costs are high and erection is slow because of wedging and nailing usually required at the bottom flange of the beam. On high structures and deep beams this procedure is dangerous because the men have to reach down to the bottom flange to make the final tightening adjustment.

Richmond Hanger Frame-Tys are ideally suited to hang this type of construction. These units in Standard, Free Fit or Offset types (see illustrations) can all be adjusted for various slab heights and haunch conditions. Their established safe working loads enable the contractor to take full advantage of lumber strength and hanger capacity.

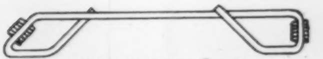
Richmond Standard and Offset Hanger Frame-Tys can be erected with a minimum of reaching under the *top* flange of the beams. Richmond Free Fit Hanger Frame-Tys have an additional advantage: all tightening is done from the top of the hanger by means of the nuts (see circle in large illustration), the Tylag passing freely thru an oversized coil.



Standard Hanger Frame-Ty



Offset Hanger Frame-Ty



45° Fascia Hanger Frame

Dual uses of these Richmond Hangers have become standard: Fascia Hanger Frame-Tys used not only to hang the forms but also tie in the Fascia Ty; a variation of this is the 45° Fascia Hanger Frame for light overhang, where one 45° bolt supports the fascia overhang and hangs the form; Hanger Frame Screeds combine support of the deck forms with an adjustable base for screeding or supporting curb forms.

Richmond Hanger Systems have reduced the contractor's overhead in time and materials, added safety to his operation and improved the quality of his work. The various types of Richmond Hanger Systems and their applications are detailed in the **NEW** Richmond Catalogue. Write for your copy. Or, if you have specific concreting problems, Richmond's Technical Division or field men will be glad to advise you. Write: RICHMOND SCREW ANCHOR COMPANY, INC., 816 Liberty Ave. Brooklyn 8, N. Y. or 315 S. 4th St., St. Joseph, Mo.

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WHATEVER THE SITE

Chicago, Ill.—Installing 24″ Mechanical Joint cast iron pipe for water line rerouted due to construction of underground garage beneath Michigan Avenue.

Hickory, N. C.—High beam strength of Cast Iron Pipe makes it particularly adaptable to this type of construction on outfall sewer.

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there's a Cast Iron Pipe for the job

WHAT'S YOUR PROBLEM?

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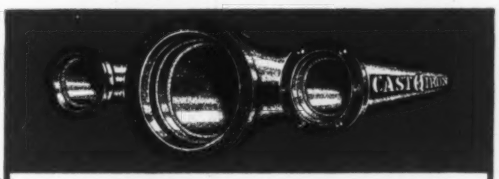

6 reasons why Cast Iron Pipe is #1 choice of U. S. A.

1. **HIGH FLOW CAPACITY...** Cement lined cast iron pipe and fittings will not tuberculate . . . delivers a full flow for the life of the pipe.
2. **LONG LIFE...** 42 North American cities are still using cast iron water mains laid 100 years and more ago. Hundreds more have passed the 50 year mark.
3. **BEAM STRENGTH...** Cast Iron Pipe is inherently tough . . . stands up under heavy traffic load, soil displacement and disturbance.
4. **EXTERNAL LOAD RESISTANCE...** 6" Class 150 Pipe withstands a crushing load of 17,900 pounds per foot . . . nearly 9 tons.
5. **CORROSION RESISTANCE...** Cast Iron Pipe effectively resists corrosion . . . vital factor in its long life and dependability.
6. **TIGHT JOINTS...** A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available for all conditions.

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Hilly country or flat, city street or rural lane, under superhighways, railroads or rivers.

But whatever the site or situation you *can* be sure of this: with cast iron pipe properly installed there'll be no trouble on or after the job.

Dependability, long life are built into every rugged length of cast iron pipe. Dependability *proved,* not merely promised.

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Three models to help you match your job needs........................

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In 1957, earth movers the world over bought more Allis-Chalmers motor scrapers than ever before. This growing popularity is the best proof of the productivity and reliability of this outstanding line. There are good reasons for the trend toward Allis-Chalmers construction machinery . . . investigate these advantages before you buy. When you've seen and tried these high-performance motor scrapers, you'll know why more dirt movers every day . . .

Look ahead*...move ahead...*and stay ahead

in motor scrapers

TS-260 A new measure of performance in this size range . . . 200 hp . . . 14 yd . . . full 90-degree turning.

TS-160 True versatility and economy in a utility machine . . . 155 hp . . . 9½ yd . . . turns non-stop in less than 25 ft.

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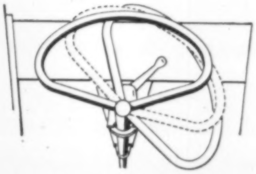
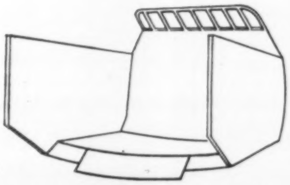
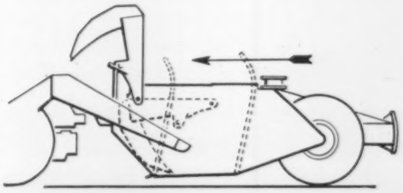


SELECTIVE HYDRAULIC STEERING . . . accurate, sure control at any speed . . . fast, full-swing steering with a 30-degree turn of the steering wheel right or left.



LOW, WIDE BOWL . . . loads full — fast — with low resistance, live action.



POSITIVE FORCED EJECTION WITH HIGH APRON LIFT . . . speeds unloading cycles. Apron opens high as positive ejector dozes out the load . . . clean and quick.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

with ALLIS-CHALMERS

A-C
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This advertisement was prepared exclusively by Phototypography

DU PONT

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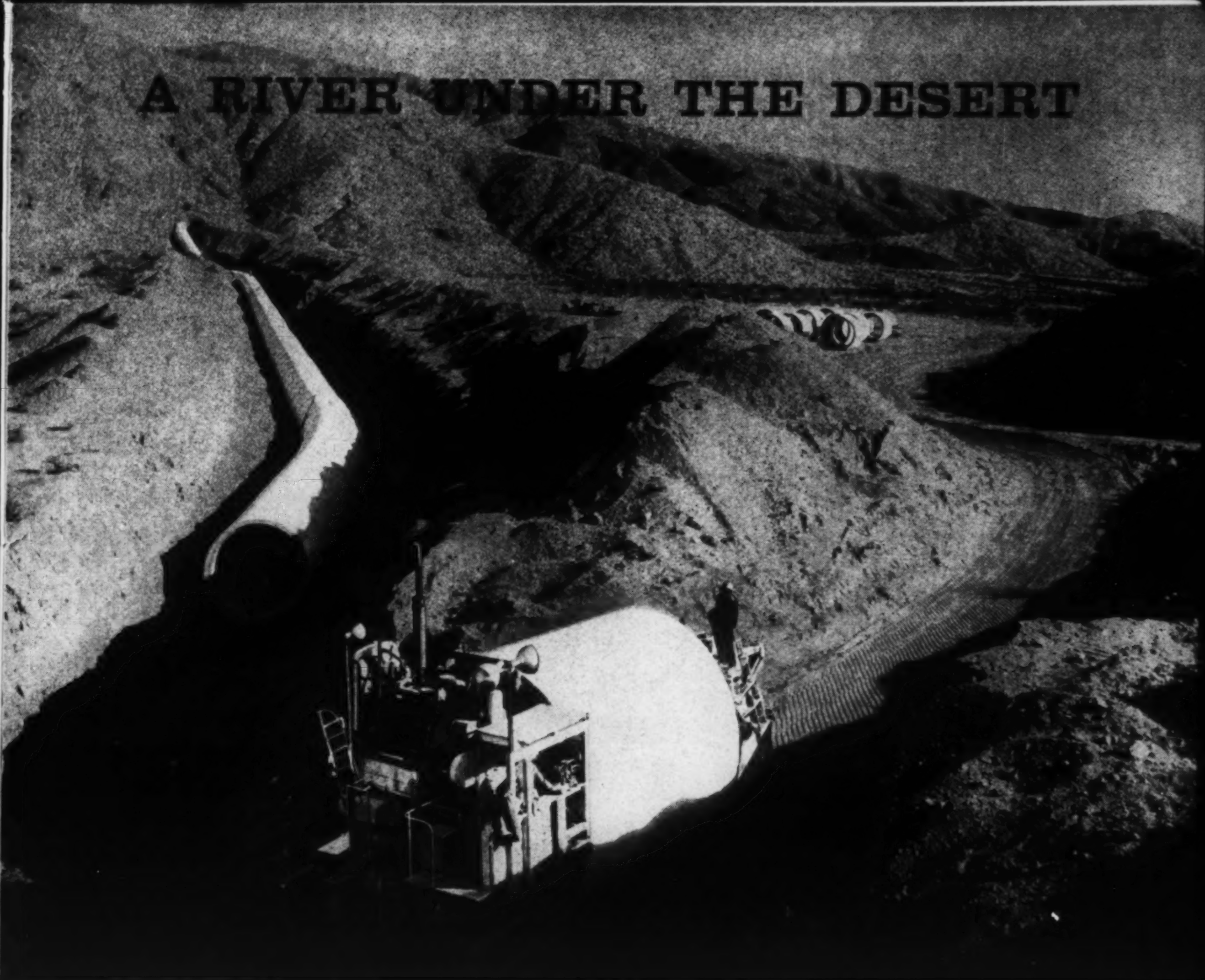
Better Things for Better Living . . . *through Chemistry*

A RIVER UNDER THE DESERT



American Pipe and Construction Co. is engaged in the manufacture and installation of 63,000 ft. of reinforced concrete pipe for 47 inverted siphons of the Colorado River Aqueduct. The siphons, widely spaced along a 183-mile segment of the aqueduct, are part of the program of the Metropolitan Water District of Southern California to bring the gigantic water supply line to full planned delivery capacity of over a billion gallons of water per day.

American's solutions to the remote location and magnitude of the project include the establishment of two on-the-project manufacturing plants. Hauling of 13 ft. 6 in. diameter 68-ton sections of pipe is being accomplished with specially designed 99 ft. trailer-rigs. Approximately 180 miles of access roads are to be constructed before the job is completed in December, 1958. American designed and built the machine shown above to meet special installation problems posed by trenches 125 ft. wide and 50 ft. deep, with slopes up to 50%. This unique "Pipemobile" actually carries and installs the pipe.

Today, American Pipe and Construction Co. is more than ever capable of handling problems involved in long-distance transmission of large volumes of water. Fifty years of experience and extensive production facilities are available to help solve any water supply or transmission problem.

American
PIPE AND CONSTRUCTION CO.

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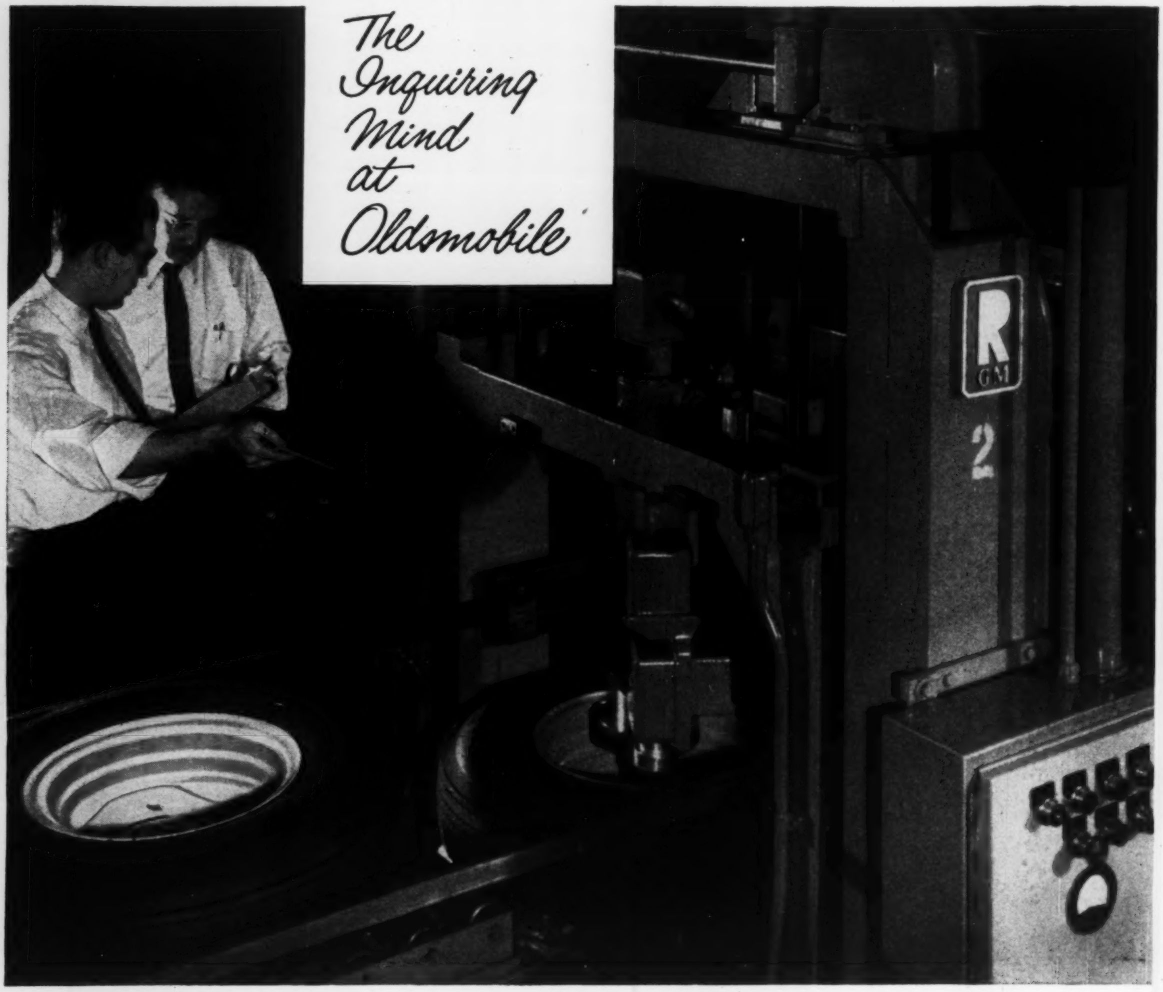
Hayward: P.O. Box 630—JEfferson 7-2072
San Diego: P.O. Box 13—CYpress 6-6166
Phoenix: 2025 South 7th St.—ALpine 2-1413
Portland: 518 N.E. Columbia Blvd.—BUtler 5-2531

Project plants, such as this one located near Desert Hot Springs, California, incorporate all essential manufacturing operations of permanent plants and bring greater economy and coordination to such large projects.

CONCRETE PIPE FOR MAIN WATER SUPPLY LINES, STORM AND SANITARY SEWERS, SUBAQUEOUS LINES



no.3 OF A SERIES

TIPPING THE BALANCE IN YOUR FAVOR

New Olds-developed machine makes wheel balancing three times more accurate!

Out-of-balance wheels and tires are not only a source of annoyance and tire wear, but also in extreme cases, a detriment to safety by causing excessive shimmy at higher speeds.

To virtually eliminate this problem, Oldsmobile engineers, in conjunction with the General Motors Research Section, have developed a machine that automatically balances every wheel and tire with a degree of precision not previously possible on a production basis. With this equipment, balancing is now accurate to 2 inch-ounces, or approximately three times more precise than before.

The heart of such accuracy is an automatic electronic computing device. After the tire and wheel are located on a delicate sensing table, supported on an air bearing, four differential transformers signal the out-of-balance to an electronic computor. This computor then resolves the vector forces and a signal of the proper magnitude and direction is transmitted to the stamping head which automatically revolves to the correct location on the wheel. The stamping head then prints the correct weight, accurate to .25 ounce. The entire assembly is then moved to a station where the weights are attached.

It has often been said that "Olds really knows how to put a car together." This reputation grew from a sincere concern for just such little-noticed details. A warm welcome awaits you at your Olds dealer's. He invites you to try a '58 Olds on the road.

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GENERAL MOTORS CORP.

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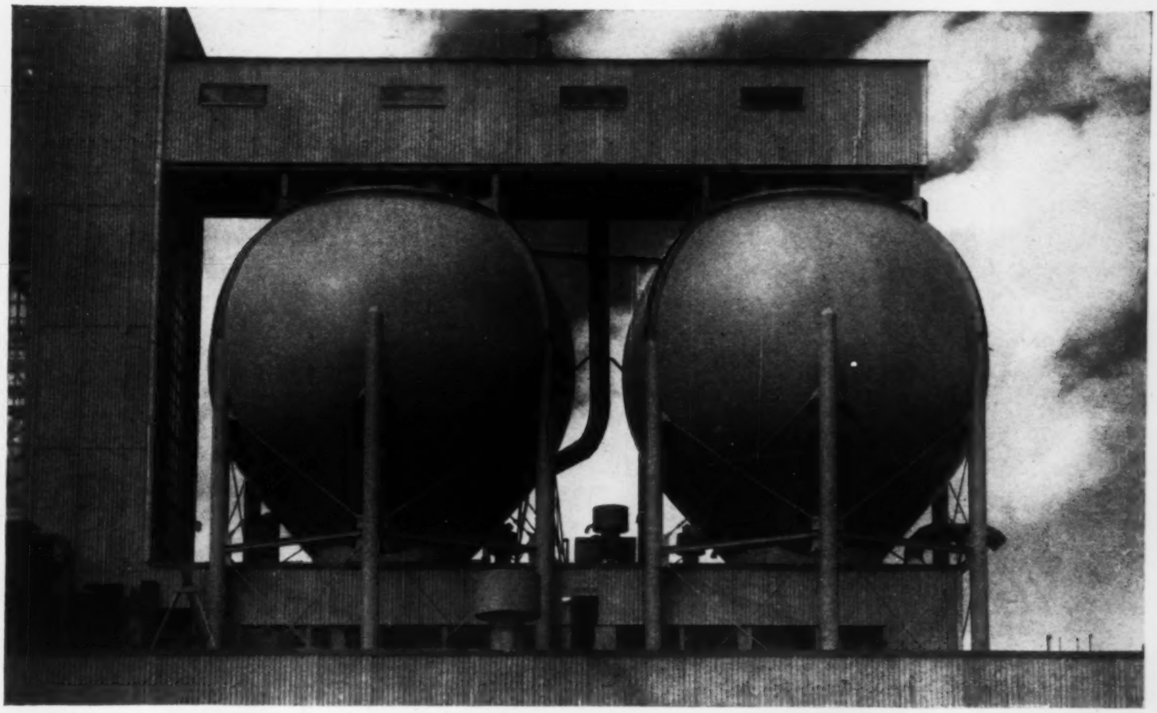
...Famous for Quality Manufacturing

The Case of the Airborne Conispheres:



Why Linde wanted them . . . How CB&I designed and built them

In order to keep a ready and free-flowing supply of calcium carbide available for generation into acetylene, the Linde Company specified that these two 500-ton capacity Conispheres* be installed on the roof of their Montague, Michigan, plant. In order to overcome a specific set of problems it was necessary for CB&I to incorporate special features into their design and construction. Here's how it was done:

Problem: *Insure safe, continuous operation.*

Solution: (1) Structures were designed to meet a specified emergency condition at an increased stress level, as well as to meet normal service conditions at normal stress levels in all parts not governed by explosion conditions. (2) A series of six safety outlets vent tanks upward. (3) Heavy baffle plates were suspended inside the tanks to control flow of carbide.

Problem: *Tanks must support superimposed load of gallery and feed belt equipment.*

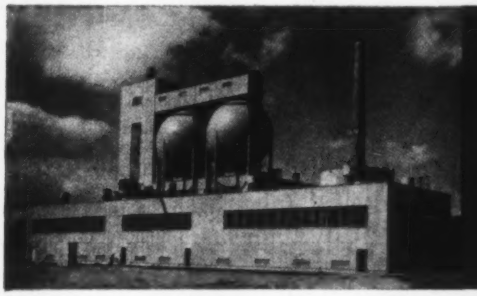
Solution: Special framing distributes load to supporting columns of the tanks.

Problem: *Tanks must be mounted on sloping roof.*

Solution: Three of the supporting columns are longer than others to compensate for roof plane.

Fully coordinated facilities for the design, fabrication and erection of standard or special steel plate structures permits CB&I to work to the most exacting requirements. . . . For this reason industry leaders call on CB&I for the tough jobs and rely on the quality of workmanship that goes into *any* CB&I built structure. A new booklet describes CB&I FIELD SERVICES . . . write our nearest office.

At Montague, Michigan, Linde is one of three major companies combining their talents and mass production facilities to produce DuPont *Neoprene.* Linde Company is a division of Union Carbide Corporation.



*A Conisphere is a Hortonsphere® designed with conical bottom outlet.

E55C

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY,
GREENVILLE, PA. and NEW CASTLE, DEL.

REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

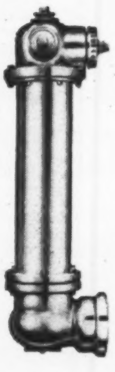
Our representative can explain to you how simplicity of design minimizes maintenance—and to see the R. D. Wood Hydrant you needn't leave your office chair.

"Don't Get Up! Sit Right Where You Are and Let Me Show You the R. D. Wood Hydrant"

"With this scale model I can show you why the R. D. Wood Hydrant has earned its reputation for reliability, strength and permanence. It is simple in construction, too—a fact that makes it low in cost and easy to repair in case of accident.

"The full area main valve is cone shaped to prevent water hammer. It opens *against* water pressure, so that if it is broken in a traffic accident, water pressure will hold it closed. This prevents loss of water, lowering of water pressure, and flooding."

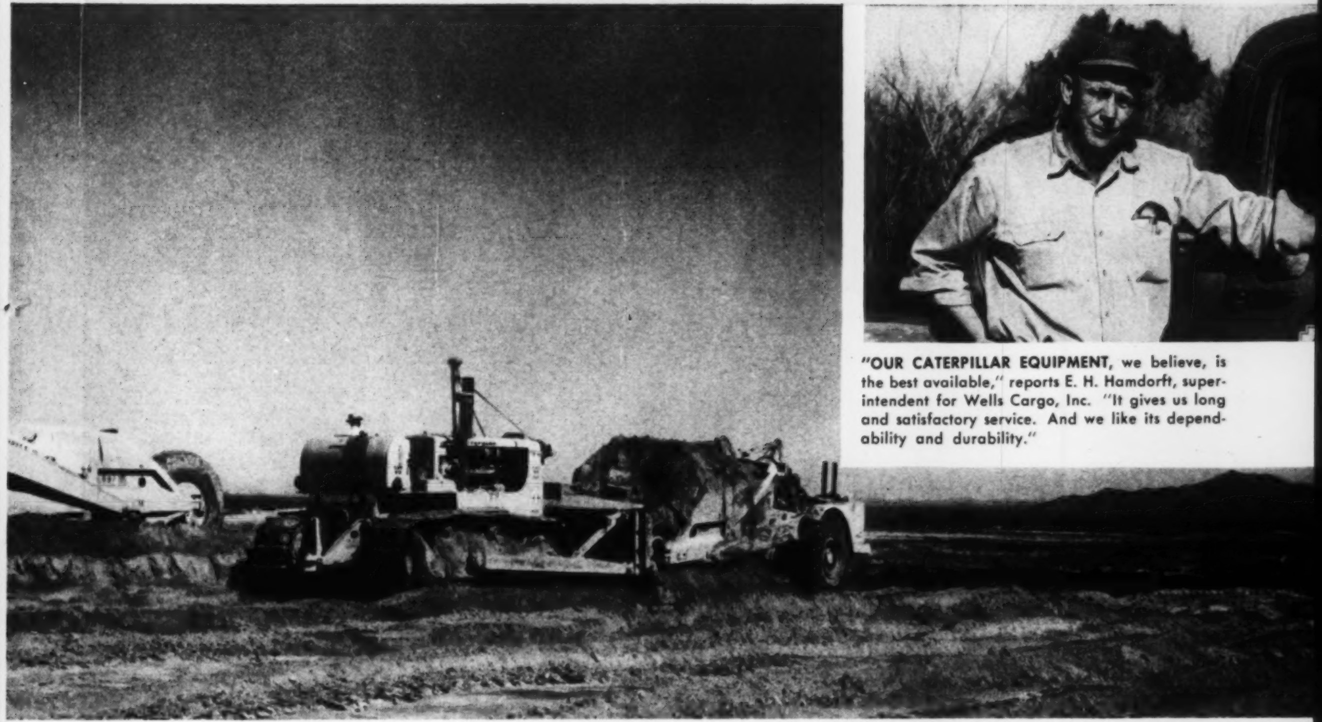
Would you like to see it? Our representative will bring in a scale model and show you its advantages right in your office. Drop us a line today and he will telephone you for an appointment at your convenience.



R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.
Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

Loading time: 47 seconds on Picacho Reservoir job



"OUR CATERPILLAR EQUIPMENT, we believe, is the best available," reports E. H. Hamdorft, superintendent for Wells Cargo, Inc. "It gives us long and satisfactory service. And we like its dependability and durability."

WITH THE HELP OF A D9, DW21s are making 1,000-foot round-trip hauls in 2½ minutes.

Nine miles south of Coolidge, Ariz., Wells Cargo, Inc., of Las Vegas, Nev., is moving earth for the Picacho Reservoir. The job calls for moving 450,000 cu. yd. for the five miles of levee, and 40,000 yards for the core fill. To do this job on schedule, Wells Cargo is relying on a big Caterpillar fleet because of its "dependability and durability."

King of the fleet is the Cat D9 Tractor which, in addition to bulldozing, is pushloading five DW21s. By using the power of the D9 as a pushloader, Wells Cargo found that it cuts loading time by 43 seconds. It can get a heaping load in just 47 seconds, and make a 1,000-foot round trip in 2½ minutes.

This big tractor always pays its keep. Everywhere it is put to work, it cuts costs by stepping up production. Its 320 flywheel HP means fast production on any kind of big job. Built for long life under the most severe operating conditions, it combines the versatility and economy of diesel power with the power-boosting efficiency of a turbocharger. Despite its size, it responds quickly, surely and accurately. Hydraulic boosters provide power for steering, braking and master clutch use.

One of these giant tractors can be equipped to your own special needs by your Caterpillar Dealer. You can have the D9 with torque converter or direct drive with oil clutch. Why not see for yourself what it can do to step up production on *your* job? Ask your Caterpillar Dealer for a demonstration.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

THE D9 FOR HIGH PRODUCTION AND LOW UNIT COST ON BIG JOBS

Aluminum fencing's amazing record:
30 RUST-FREE YEARS
WITHOUT PAINTING

Chain Link Fencing of Alcoa Aluminum Now Available Throughout U.S. to Help You Cut Maintenance

Chain link fencing of Alcoa® Aluminum, for highways, divider strips and rights-of-way, is a bigger bargain than ever: the premium you pay for aluminum now amounts to *less* than the cost of one routine painting of ordinary metal fencing.

From this point on, you're money ahead with aluminum. This was proved recently by examination of an aluminum fence installation in Pittsburgh. Installed 30 years ago in a continuously corrosive atmosphere, it is still standing today and will probably live to be 100! The aluminum still has its original structural soundness and rust-free good looks . . . has never cost a penny in maintenance.

Long-life, trouble-free installations like this are typical, but check the many other exclusive advantages you get with fencing of Alcoa Aluminum:

- **High Strength**—Average tensile strength of Alcoa's new alloy is 57,500 lbs/sq in.
- **Easy Erection**—Light weight means it goes up faster with less labor.
- **Enduring Beauty**—Aluminum ages to a pleasing, soft gray; never rusts or peels.
- **Readily Available**—Reliable manufacturers and erectors in all 48 states can supply Alcoa Aluminum fencing and accessories. For the name of the supplier in your area, contact your nearest Alcoa sales office.

Send for Complete Specifications!

Alcoa's A.I.A. File 14-K contains complete specifications and technical data. For your copy, write Aluminum Company of America, 1979-F Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Your Guide to the Best in Aluminum Value

"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

A REMINDER:

All papers for the $1000

ALFRED A. RAYMOND AWARD COMPETITION

must be submitted by September 1, 1958

An award of $1,000 will be given annually in honor of Alfred A. Raymond, inventor of the cast-in-place concrete pile and founder of Raymond Concrete Pile Company. It will be presented to the author of the best original paper on "Design and Construction of Foundations for Structures," as selected by a committee of eminent judges. Authors of manuscripts, to qualify, must hold a degree in engineering from an accredited institution.

The topic "Design and Construction of Foundations for Structures" is to be interpreted broadly. It covers all phases of foundation engineering from the initial planning to the final installation of a foundation for a structure. Engineers are cordially invited to submit a paper on whatever aspect of foundation engineering or construction of foundations will contribute to knowledge in the field. Manuscripts may deal with foundation test borings, soil mechanics, the theory of foundation design, actual foundation construction, either temporary or permanent, and other related subjects.

If you are a practicing engineer, engineering faculty member or a graduate student and wish to compete for this award, simply write for a complete set of detailed regulations: Dept.C-4 Alfred A. Raymond Award, Room 1214, 140 Cedar Street, New York 6, N. Y.

NEWS OF ENGINEERS

Thomas C. Kavanagh, of Praeger-Kavanagh, Engineers of New York, has received the D. B. Steinman Award for Research in Structural Engineering for his paper entitled "Rational Simplifications for the Buckling Lengths of Columns." The announcement of the award came from the New York Academy of Sciences.

Leon G. Rucquoi announces the incorporation of his industrial consulting activities under the name of Leon G. Rucquoi and Associates, Inc. The offices of Mr. Rucquoi's firm will be at 30 Rockefeller Plaza, New York City. He was previously technical consultant to the Steelmakers and Metal Working Industries of Belgium and Luxembourg.

William S. La Londe, Jr., chairman of the department of civil engineering at the Newark College of Engineering, has been retained as a consultant by the U. S. Army School at Fort Belvoir. In his capacity there, Professor La Londe will assist in the development of a non-resident Professional Engineer Preparatory Course. He has had more than 20 years' experience in preparing and administering New Jersey state examinations. Professor La Londe is a former Director of ASCE.

William T. Collings and **Emil F. Vranich** announce the formation of the consulting engineering firm of Collings-Vranich and Associates, Inc., in Milwaukee, Wis. The new firm will render engineering design services to architects and industry.

L. J. Lincoln

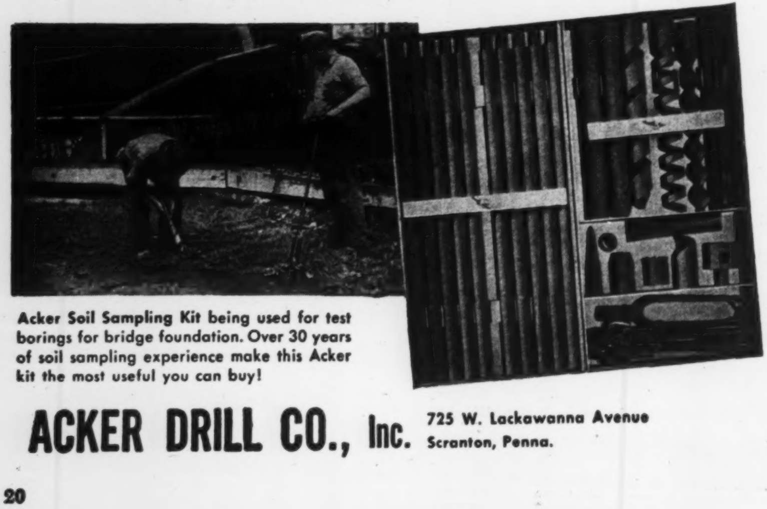
L. J. Lincoln, Brigadier General, Corps of Engineers, Mediterranean Division Engineer, has been assigned to Washington, D. C., where he will be in the office of the Army Deputy Chief Staff for Logistics. General Lincoln has served in the Mediterranean Division since 1956, and will report to Washington in July. General Lincoln's responsibilities in the Mediterranean Division included Italy, Iran, Greece, Turkey, Pakistan, Morocco, Libya and Eritrea.

William A. Shapiro has been elected secretary of Ramseyer and Miller, Inc., iron and steel consultants in New York City. Mr. Shapiro has served Ramseyer and Miller as project engineer for several years.

DON'T GUESS!

use an ACKER SOIL SAMPLING KIT for accurate sub-surface information

With accurate sub-soil information, *you avoid* costly trouble later on. And, what better way to get this information than with a portable, easy to use Acker Soil Sampling Kit. For here is a versatile collection of twelve soil sampling tools packed in a handy steel kit that can be carried in any car.
Write today for prices and Bulletin 26. CE



Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

ACKER DRILL CO., Inc. 725 W. Lackawanna Avenue
Scranton, Penna.

Frank S. Besson, Jr., Major General, U. S. Army, has assumed new duties as Army Chief of Transportation with headquarters in Washington, D. C. Major General Besson has served previously with the Logistics Division of SHAPE.

Wallace W. Sanders has been appointed director of city works for Louisville, Ky. For 12 years Mr. Sanders has served as chief engineer and has recently been holding the post of acting city works director.

Williams D. Bailey has been admitted to partnership in the New York City firm of Seelye Stevenson Value and Knecht. Mr. Bailey was formerly an associate in the firm, and will continue to act as manager of the Highway Engineering Division. The firm will continue its practice of general consulting engineering under the name of Seelye Stevenson Value and Knecht.

D. E. Westervelt

Dan E. Westervelt has been appointed to the sales engineering staff of the Montebello fabricating division plant of Kaiser Steel. Before joining Kaiser in 1957, Mr. Westervelt was engaged in government work, serving as chief supply service director for the U. N. Korean Reconstruction Agency and as consultant for the General Service Administration.

Charles A. Schank, chief of the Chart Division of the U. S. Coast and Geodetic Survey, Washington, D. C., retired on April 1 after a career of more than 32 years with the Survey in a number of responsible capacities. Upon his retirement, Captain Schank was promoted to rear admiral in recognition of meritorious service in combat during World War II. He is the holder of many decorations received during the war, when he transferred to the Army for temporary combat service. He is living at 1049 Robin Way, Sunnyvale, Calif.

Daniel Koffler announces the opening of the office of Daniel Koffler and Associates in New Castle, Del. Mr. Koffler's firm will practice structural, mechanical and sanitary engineering and plans to work in the field of bridges, special structures, cold storage warehousing, industrial developments, parking garages, and airplane hangars.

B. J. Fletcher has been elected a vice-president of the Aluminum Company of America, Pittsburgh. Mr. Fletcher has been with Alcoa since 1926 and at the time of his election was general manager of engineering.

Charles H. Mottier has retired as vice-president in charge of engineering for the Illinois Central Railroad. Mr. Mottier has served the railroad for 47 years and has headed the engineering department since 1942.

W. L. Sheets has been elected a vice-president of Stone and Webster, Boston and New York engineering and construction company. Mr. Sheets was formerly construction manager for the company in Boston. He joined Stone and Webster after 15 years with the Corps of Engineers and various power and irrigation organizations.

Lynn S. Beedle and **George C. Driscoll, Jr.**, have received the American Welding Society's A. F. Davis Silver Medal for a joint paper. Mr. Beedle is research associate professor and Mr. Driscoll, assistant professor, both at Lehigh University. The award is sponsored by A. F. Davis, vice-president of the Lincoln Electric Company, and is awarded annually for the best paper published in the *Welding Journal*. The joint paper for which the medal was given this year is entitled "The Plastic Behavior of Structural Members and Frames."

V. M. Freeman

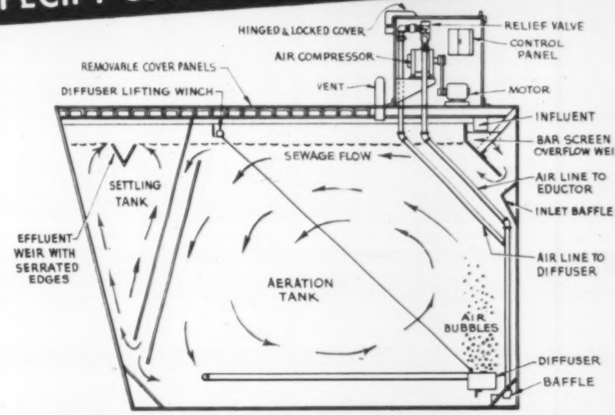
V. M. Freeman, veteran water supply expert, is opening his own office as a consultant in Santa Paula, Calif. For the past 23 years Mr. Freeman has served in the triple function of managing engineer to the Santa Paula Water Works, the Farmers Irrigation Company and the Thermal Belt Mutual Water Company. As a consultant, Mr. Freeman will offer his services in the field of water supply engineering.

The partnership of Edwards, Kelcey and Beck announces the dissolution of the firm. **Dean G. Edwards, Guy Kelcey** and **William L. Hanavan** will continue to practice consulting engineering under the name of Edwards and Kelcey. The firm will have offices at 3 William Street, Newark, N. J.; 625 Eighth Avenue, New York City; and 470 Atlantic Avenue, Boston, Mass. **Lawrence T. Beck** will continue the practice of consulting engineering as Lawrence T. Beck and Associates with offices located in the Alison Building, Rittenhouse Square, Philadelphia; 9 East 40th Street, New York City; and 1025 Connecticut Avenue, Washington, D. C.

(Continued on page 22)

The Smith & Loveless *APPROVED
FACTORY-BUILT
SEWAGE TREATMENT PLANT

SPECIFY SMITH & LOVELESS "OXIGEST"



Smith & Loveless offer the low cost "Oxigest" sewage treatment plant for sub-divisions, schools, motels and industrial plants. The "Oxigest" is designed and built with the same care and precision that have made the Smith & Loveless factory-built sewage lift stations so widely accepted and specified.

The "Oxigest" has been carefully engineered for dependable treatment without requiring a skilled operator.

Completely protected by Smith & Loveless "Versapox" coating and magnesium anodes.

Built of the finest materials, the "Oxigest" will provide a permanent plant with minimum annual maintenance.

Smith & Loveless "Oxigest" plants are available in five standard sizes, to cover a wide range of applications.

*Approved by F.H.A. and State Health Departments where submitted. Now you can provide complete sewage facilities by specifying Smith & Loveless.

- Completely assembled at the factory
- Factory tested and adjusted before shipment
- Shot blasted steel structure, protected by Smith & Loveless "Versapox" and magnesium anodes
- Properly reinforced to withstand interior and exterior pressures
- Built of the finest materials under rigid factory supervision
- Delivered to job site on special Smith & Loveless trucks
- Quickly, easily installed

WRITE FOR Smith & Loveless data manual which describes in full the selection, construction, installation and operation of the Smith & Loveless "Oxigest" sewage treatment plant. **ALSO AVAILABLE,** The Smith & Loveless sewage lift station data manual. Contains over 100 pages of specifications, dimension drawings, capacity charts, etc.

WRITE DEPT. 80 No obligation

MANUFACTURERS OF WATER & SEWAGE TREATMENT EQUIPMENT

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Big Tanks...
Little Tanks
for
FIRE PROTECTION
AND OTHER
INDUSTRIAL
WATER NEEDS

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EAST CHICAGO, INDIANA
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Springs, Oklahoma • Houston • Los Angeles
Fontana, California • San Francisco

The Dependable Source
for Elevated Water Tanks
GRAVER
Our 100th Year

News of Engineers

(Continued from page 21)

S. P. Curtis has been appointed chief engineer, central operations—steel and coal, of the United States Steel Corporation. Prior to his appointment as chief engineer at the Fairless Works in 1955, Mr. Curtis played an important role in the construction of the integrated steel plant at Morrisville, Pa.

Francis J. Murphy, chief engineer of the Judson-Pacific Murphy Corporation of San Francisco, has been appointed a director of the Central Valley National Bank. Mr. Murphy is also chairman of the board of the Maritime Equipment and Precast Concrete Corporation and project manager of the new Glen Canyon Bridge in Arizona.

J. G. Zeitlen has been elected dean of the faculty of civil engineering at Technion in Haifa, Israel. Mr. Zeitlen, United Nations expert in soil mechanics, has initiated several soil mechanics research projects since he went to Israel in 1953, and has played an active part in the establishment of a Soil and Engineering Division at Technion.

John C. King has been appointed manager of sales for Intrusion-Prepakt, Inc. He will have his headquarters in Cleveland in the company's executive offices. Mr. King joined Intrusion-Prepakt in 1947 as chief engineer after work with the Corps of Engineers and the Bureau of Reclamation. **Bruce A. Lamberton** will take over the post of chief engineer. Mr. Lamberton has been with the company since 1948 and has completed field assignments in this country and abroad. He has held the position of manager of research and development for the past three years.

J. C. King

B. A. Lamberton

Archie E. Floyd, Lieutenant, Civil Engineer Corps, U. S. Navy, has reported to the U. S. Naval Engineering Experiment Station, Annapolis, Md., where he will serve as public works officer. Lieutenant Floyd previously was public works officer at the U. S. Naval Training Device Center in Port Washington, N. Y.

Thomas B. Powell, manager of the Contractors' Equipment Department of the Banks-Miller Supply Company, has been elected president of the Huntington (W. Va.) Engineers Club.

Gene Sembler has been elected president of the Galveston (Tex.) Junior Chamber of Commerce. Mr. Sembler is chief engineer of the port of Galveston where he has served for three years.

Harold A. Price, vice-president and director of the Prestressed Concrete Institute, will represent the Freyssinet Company on the West Coast. Mr. Price, who was formerly with the Basalt Rock Company, will coordinate engineering promotional activities for Freyssinet with his factory representation job for manufacturers. He will be located in Napa, Calif.

D. B. Freeman

Delbert B. Freeman, Colonel, U. S. Army (retired), has joined the Fruin-Colnon Contracting Company in St. Louis, Mo., as vice-president and director in charge of foreign operations. Colonel Freeman recently served as chief of the U. S. Army mission to Bolivia where he was adviser to the Bolivian government on all military matters affecting the Bolivian army as well as on engineering activities both within and without the military establishment.

R. L. Peurifoy, professor of civil engineering at the Agricultural and Mechanical College of Texas, is taking a leave of absence from his duties, beginning September 1. He plans to spend a year on construction projects in the United States, Alaska and Mexico for the purpose of obtaining additional information on construction. Professor Peurifoy is the author of two books on construction.

C. E. Sandstedt has retired as professor of civil engineering at the Texas Agricultural and Mechanical College. Professor Sandstedt has been with the college for more than 25 years. He plans to take a cruise around the world.

L. K. Crawford, partner in Crawford, Murphy and Tilly, Springfield, Ill., has been elected first vice-president of the Consulting Engineers Council. **B. M. Dornblatt,** of B. M. Dornblatt and Associates, New Orleans, La., has been named treasurer of the Council. The Council is a national organization of some 1,000 consulting engineering firms.

The Asphalt Institute is opening a new Pacific Coast division headquarters at Berkeley, Calif., under the direction of **B. A. Vallerga.** Mr. Vallerga, a former instructor at the University of California, is the division managing engineer and now maintains his office in San Francisco. From the new Berkeley headquarters, he will direct Institute engineering services for the states of Washington, Oregon, California, and Arizona.

B. L. Robinson, Major General, Corps of Engineers (retired) has been appointed vice-president of Sverdrup and Parcel, Inc., of St. Louis, Mo. General Robinson will be in charge of the company's overseas operations.

Thomas M. Lowe, Jr., announces the opening of Thomas M. Lowe, Jr., and Associates, Inc. Mr. Lowe's firm, a civil and photogrammetric engineering concern, is located at 3166 Maple Drive, N.E., Atlanta, Ga.

R. A. Van Ness, bridge engineer with the Atchison, Topeka and Santa Fe Railway System, has retired after 41 years of service with the railroad. Succeeding him is **C. H. Sandberg,** who served as assistant bridge engineer until his promotion. **W. E. Robey** will step into the post of assistant bridge engineer. He formerly served as bridge construction engineer.

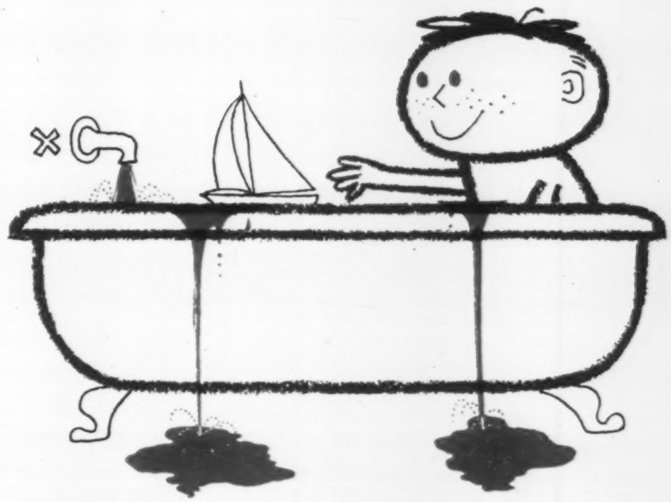
George C. Driscoll, Jr., has been promoted to assistant professor in the civil engineering department of Lehigh University. Mr. Driscoll has served as an instructor in civil engineering at the university for the past five years. He joined the staff as a graduate assistant in 1950 and was named research instructor in 1953.

John R. Snell, partner in Michigan Associates, Lansing, Mich., has been elected president of the Consulting Engineers Association of Michigan. At the annual meeting the association also voted unanimously to join the Consulting Engineers Council.

G. R. Strandberg is retiring on June 1 from the Stone and Webster Engineering Corporation, Boston, after more than 40 years' continuous service in its engineering department. During the past four years, Mr. Strandberg has been a consulting engineer with the Corporation. For a number of years earlier he was chief hydraulic engineer in charge of all hydraulic and hydroelectric engineering work. In June 1956, Mr. Strandberg was awarded an honorary degree of Doctor of Engineering by Worcester Polytechnic Institute. Mr. Strandberg is chairman of the ASCE Power Division.

A. F. Benscheidt, Commander, Civil Engineer Corps, U.S. Navy (retired), has taken the post of chief associate engineer with George F. Nicholson, Long Beach consultant. In his new association, Mr. Benscheidt will be engaged in planning, economic studies, and design of the Marina del Rey, the Port of Sacramento, the Port of San Diego, and many other projects. Prior to his recent retirement from the Navy, Mr. Benscheidt served four years as public works officer of the Long Beach Naval Station and the Los Angeles Naval Station. He was in the Navy for 20 years.

(Continued on page 122)



For maximum flow...

Rodney Hunt HY-Q Flush Bottom Closure Sluice Gates provide exclusive operating and control advantages by eliminating turbulence and impedence at the invert. Unlike any other design, the Rodney Hunt HY-Q gate seats on a sill flush with the invert. It imposes no impedence of a raised sill. There is no pocket for bottom wedges to create turbulence. Where hydraulic gradient is greatest ...at the bottom of the gate...the HY-Q gate presents a smooth unbroken surface for full, fast, non-turbulent flow.

HY-Q® SLUICE GATE

The first basic sluice gate improvement in years features a resilient seal fastened to the bottom of the sliding disc to provide a cushioned closing at the stop bar. This flush bottom closure results in the construction economies of smaller gate sizes, narrower channels and lower channel walls for a given volume of flow . . . and provides unmatched design flexibility for water, sewage treatment and similar projects.

For full design and specification data, write for your copy of Catalog 75.

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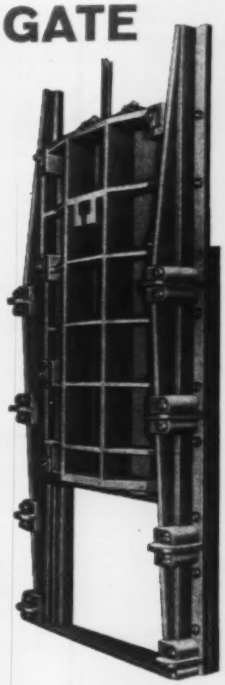
RODNEY HUNT MACHINE CO.

Water Control Equipment Division
86 Water Street, Orange, Mass., U. S. A.

Serving water control engineers with equipment and engineering



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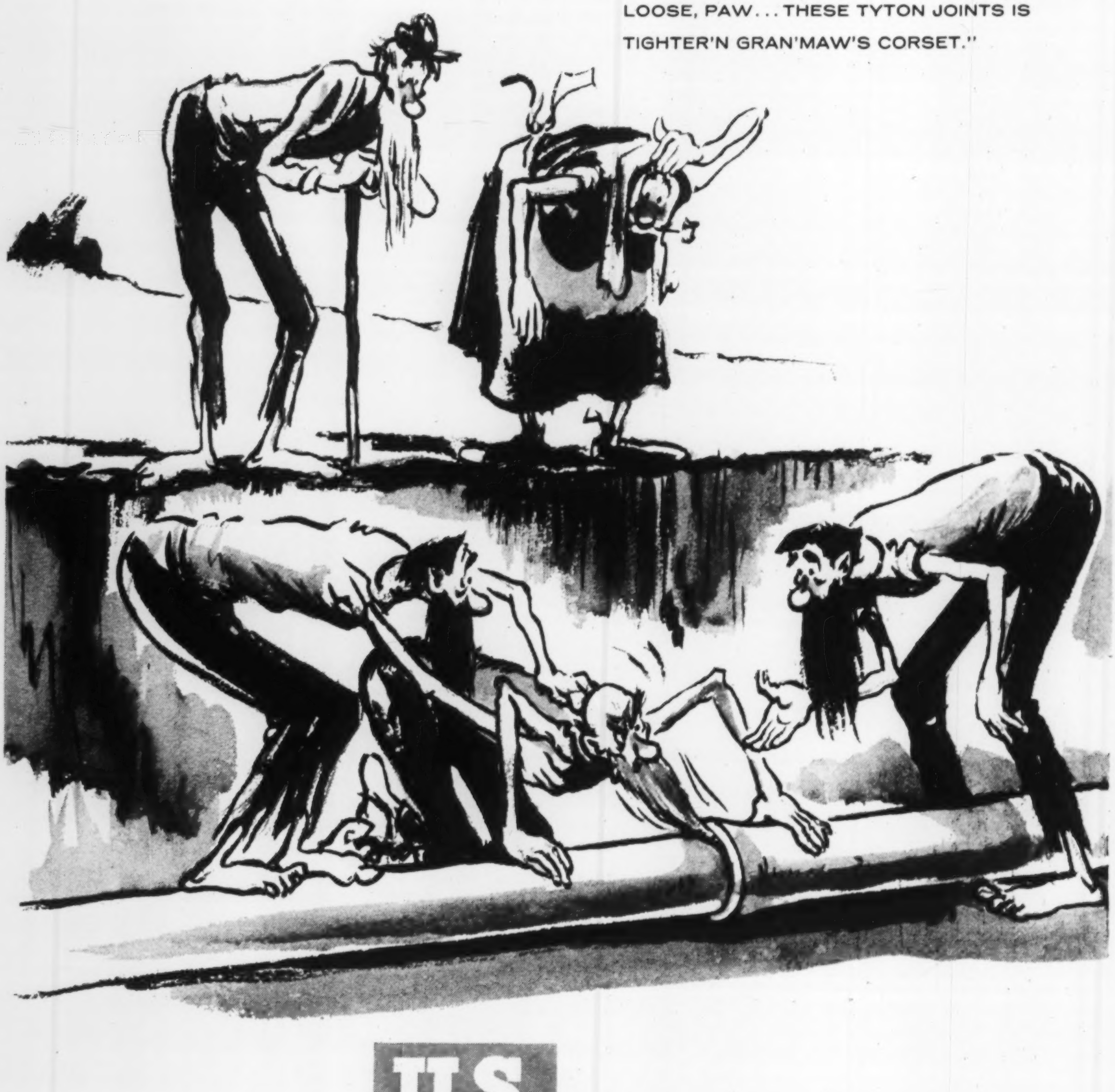


"RECKON WE'LL HAFTA CUT YORE WHISKERS LOOSE, PAW... THESE TYTON JOINTS IS TIGHTER'N GRAN'MAW'S CORSET."

U.S. cast iron PIPE

FOR WATER, SEWERAGE AND

let go!

Grandpaw's whiskers are proof! Tyton Joint® pipe seals permanently and bottle-tight.

It's easy to assemble, too. A specially designed rubber gasket fits into the bell of the receiving pipe. When the connecting pipe slides into place the gasket is compressed and presto!... a perfect fit! No bell holes, no caulking, no nuts or bolts to fasten. Even green crews look expert in handling it. Tyton Joint pipe doesn't mind the weather, either. You can lay it in rain or a wet trench when you have to.

Call or write today and get *all* the facts about Tyton Joint pipe. Facts that can save you money, time and trouble.

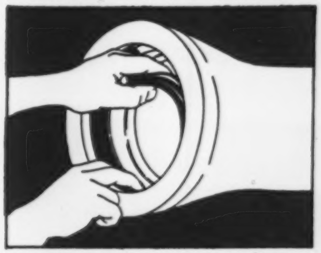
U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES
AND BLAST FURNACES TO FINISHED PIPE

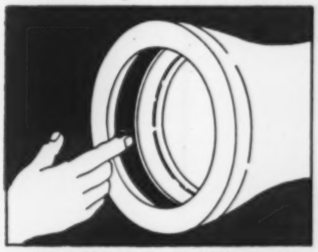
INDUSTRIAL SERVICE CAST IRON

TYTON

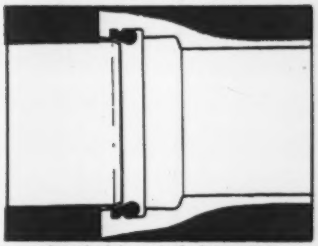
ONLY FOUR SIMPLE ACTIONS



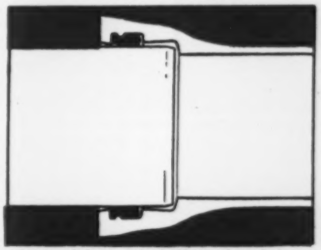
Insert gasket with groove over bead in gasket seat



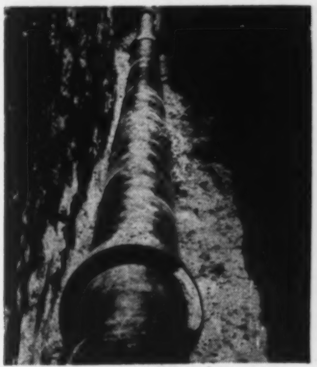
Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



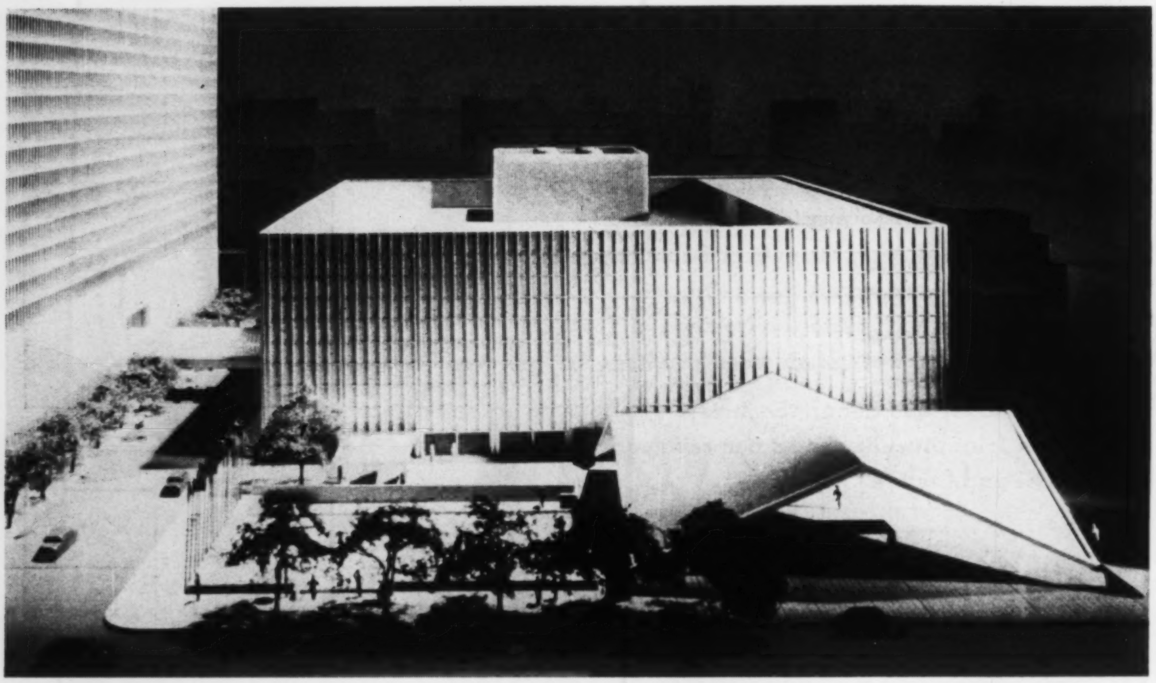
Force plain end to bottom of socket... the job's done!



12" Tyton Joint pipe for water line in Florida

The New Age of Concrete

brings greater architectural beauty and new structural form to buildings



An unusual example of the adaptability of concrete is shown in the foreground structure of the Court House Square Project developed by Webb & Knapp in Denver. Technically known as a hyperbolic paraboloid, this cast-in-place concrete shell, resting on four corners only, is self-supporting, requiring no columns or interior supports of any kind.

The beauty, economy, clean lines, grace, and enduring qualities of architectural concrete buildings make them an easy choice for almost any type of use. New finishing techniques and new concepts of structural design make possible unlimited selection of building shapes and appearance.

Ideal Cement is produced in 15 plants extending from the West Coast through the Rocky Mountain region, the Southwest, and the Deep South, which assure an ample supply of Portland cement for any architectural use.

PORTLAND IDEAL CEMENT

IDEAL CEMENT COMPANY

DENVER, COLORADO

15 Plants and 4 Terminals Serving Some of the Most Rapidly Growing Areas of the Nation.

POSITIVE CONTROL OF MATERIALS IN MOTION B-I-F

PROTECT YOUR LIQUID ASSETS

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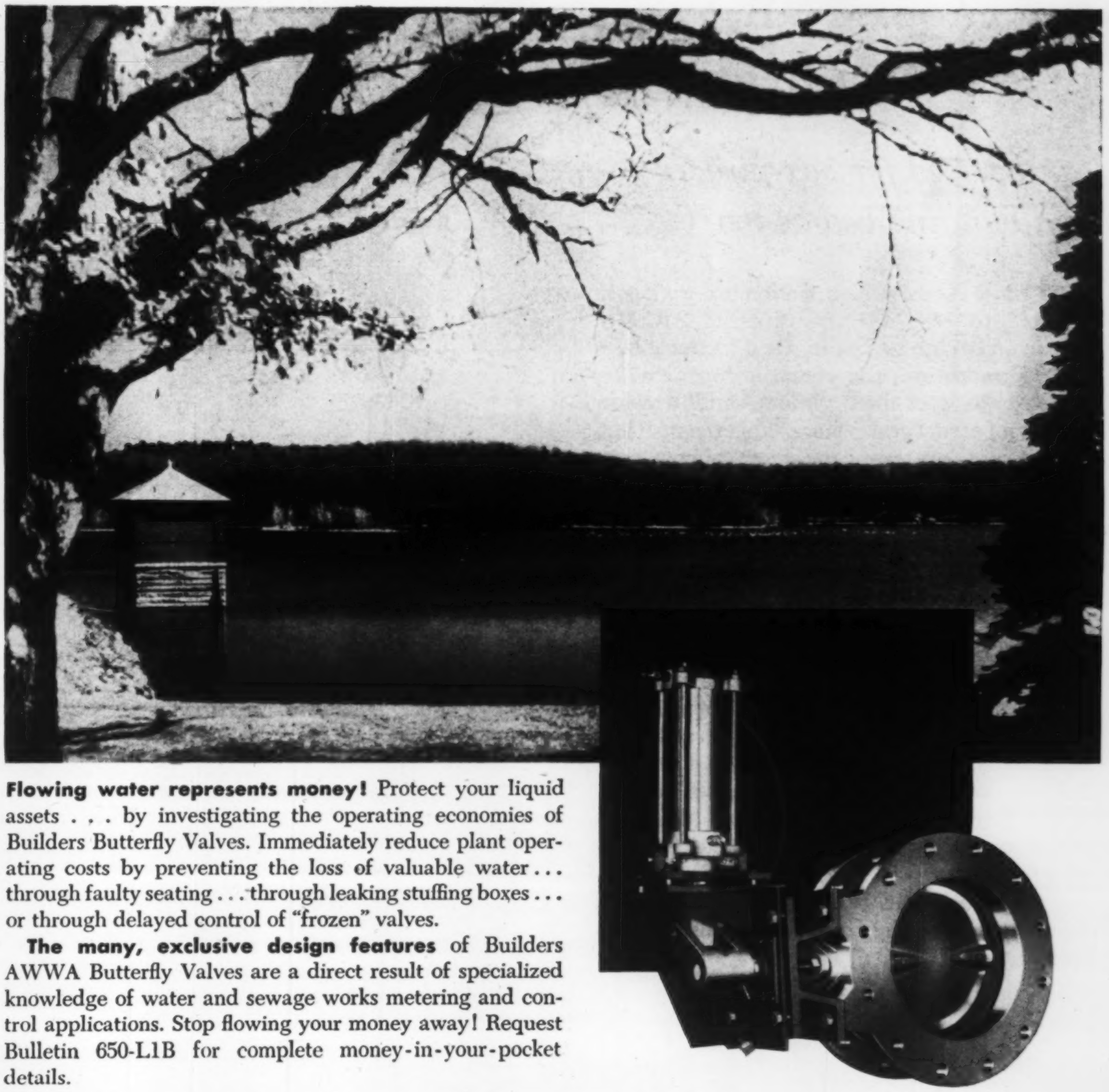

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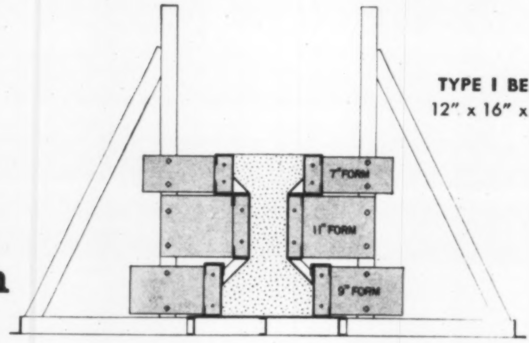

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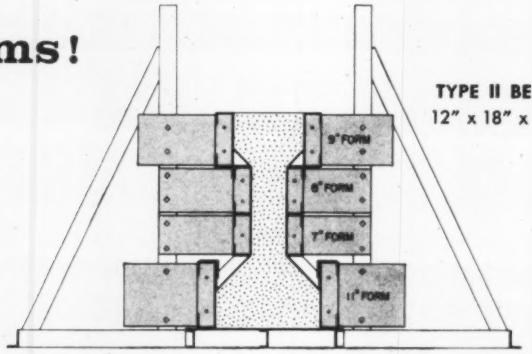

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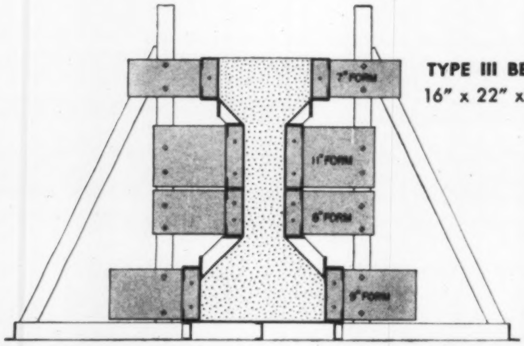

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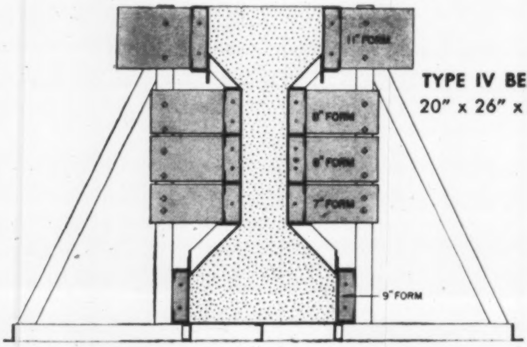

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. . . . . Am-Soc Briefs

▶ ▶ Making Society Conventions pay off. . . . With Conventions carefully planned these days "to expand the professional horizons of those who attend and make the process pleasant," it's clearly up to the conventioneer himself to make attendance pay off, says the Society's Committee on Meetings. The subject — never more timely than now, with the Portland Convention coming up in June (23–27) and the Hawaii Section's meeting and tour immediately thereafter (June 28–July 7) — is treated by the committee in a thought-provoking brochure reprinted in the "Society News" section.

▶ ▶ More insurance benefits. . . . To mark the tenth anniversary of ASCE participation in the Group Disability Plan, the administrators are offering certain additional benefits without increasing coverage costs. A brochure describing the coverage will be mailed in July.

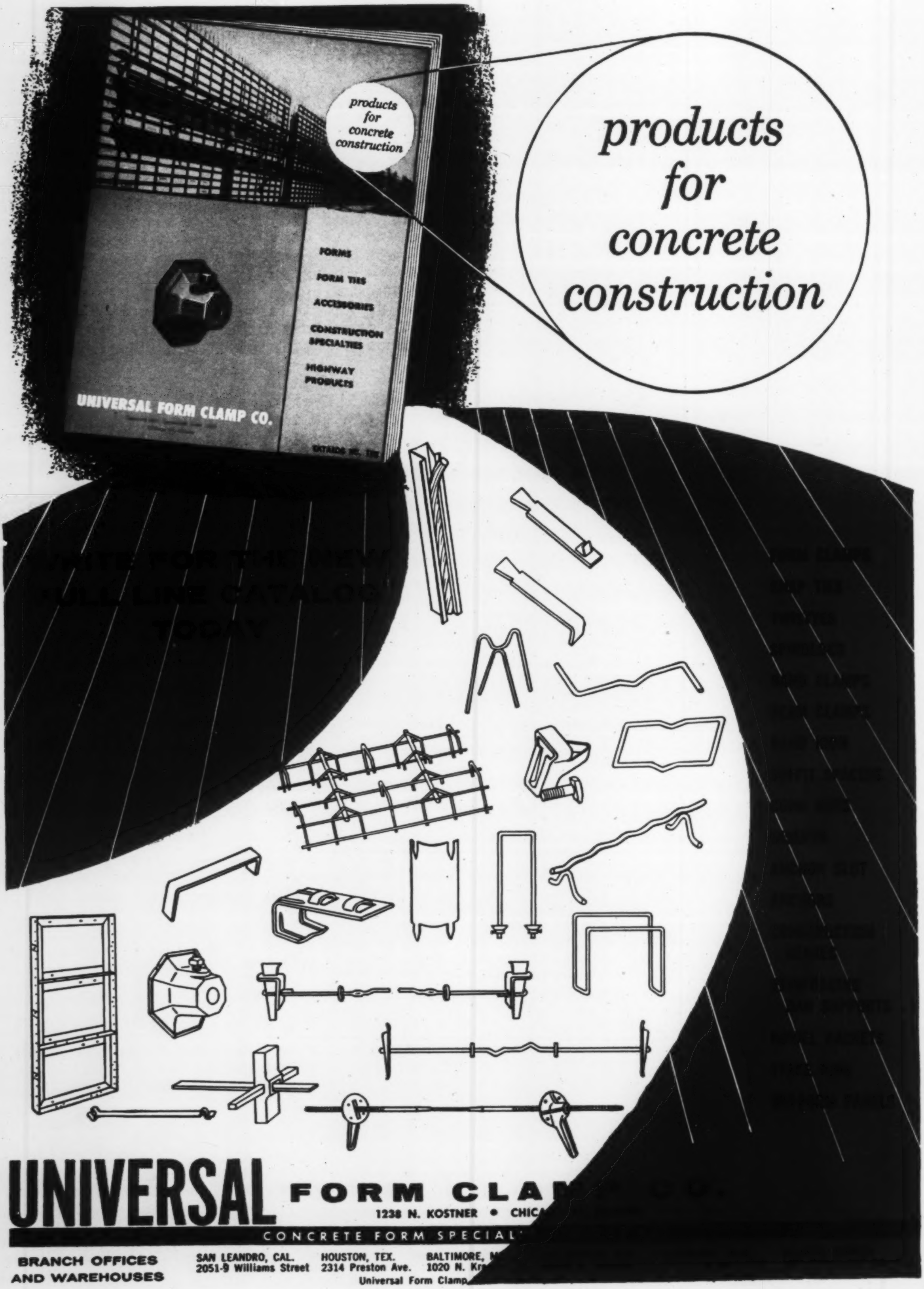
▶ ▶ Who's Who in Engineering. . . . Members wishing to be included in the eighth edition of this impressive reference, due for publication at the end of the year, must take steps now. The editors report that almost a quarter of those listed in previous editions have failed to reply to a mail canvass for up-dating purposes. Biographies that are not brought up to date will not be reprinted in the new edition, they warn. To assure inclusion engineers must respond to the inquiry sent them. Qualified persons who have not received an inquiry are urged to get in touch with the Editors of Who's Who in Engineering, 265 West 14th Street, New York 11, N. Y.

▶ ▶ A gentle reminder. . . . This is to say again that every member is entitled to a copy of the forthcoming ASCE Membership Directory, and that copies must be requested. Order forms for the Directory are on their way now. Please don't forget to request your copy.

▶ ▶ Junior Members, this is for you. . . . Don't overlook your privilege of transferring to Associate Membership as soon as you are eligible. Transfer can be accomplished without fuss or fanfare if you act before reaching the age limit for Junior Members.

▶ ▶ Fund raising for the United Engineering Center. . . . On the credit side, over $3,200,000 has been raised. . . . Before the needed $10,000,000 is obtained, the modest contribution and generous help of every single member will be needed.

▶ ▶ Speaking as one, sixteen major engineering societies have written to President Eisenhower offering their "full cooperation in the solution of the many technological problems that affect our security and economy." In an appreciative response sent at the President's request, Dr. James R. Killian, Special Assistant to the President for Science and Technology, has accepted the joint offer to use the service of engineers in an advisory capacity to government. . . . The joint action was headed by Engineers Joint Council and its president, Enoch R. Needles, Past-President of ASCE. A committee of three, named to work with Dr. Killian, consists of Mr. Needles, A. B. Kinzel, president of the AIME, and G. E. Holbrook, president of the AIChE.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Timber is our one crop in short supply? By the year 2000 the United States will need 105.4 billion board feet of lumber, but it will have only 25.2 billion board feet if current forestry practices are continued. This is the prediction of the U. S. Forest Service, which has just completed a nationwide survey of our forest resources. There is only so much forestry land (489 million acres), and 55 percent of this woodland acreage is in the hands of private owners. It's clearly up to this group to grow more trees, says the Forest Service. At the present moment some 52 million acres—an area the size of Maryland, Indiana, and Maine combined—are in serious need of replanting.

• • •

The Bureau of Reclamation is encouraging its engineers to register? Commissioner Dexheimer recommends that all Reclamation Bureau engineers register as professional engineers in the states where they are working. Though engineers in government employ are not required by law to register in order to practice as are engineers in private practice, it's a sound idea for them to demonstrate their qualification for private practice by doing so. He suggests a reading of ASCE's policy on registration—in the November 1957 issue (page 86).

• • •

World output of steel set a record last year? Steel production all over the world was at a record high of 322 million tons in 1957. This represented an 11-million-ton increase over the previous record (311 million tons) set in 1956. Nearly 243 million tons of this output came from the Free World countries, while the Iron Curtain countries produced about 79.2 million tons. The United States, since 1890 the largest steelmaking nation in the world, retained its laurels with an output of 112.7 million tons, about 35 percent of the world total. Russia was next with nearly 56.3 million tons. Source of these figures is the American Iron and Steel Institute.

• • •

Higher education leads to higher income? The U.S. Census Bureau has analyzed the educational background of Americans and compared it with their life income. The average grammar school graduate, it finds, may expect to earn $116,000, while the life income of a high school graduate is likely to be $165,000. From one to three years of college will increase life earnings to $190,000. The college graduate does best of all with an income of $268,000.

• • •

A vehicle that travels on air jets may revolutionize land travel? This is the theory of Ford Motor Company engineers, who are demonstrating a 3-ft model of a wheelless vehicle that glides on a thin film of air above a table top. The vehicle is supported by tiny jets of air streaming through holes in flat aluminum pads on its bottom surface. According to Andrew A. Kucher, vice-president of engineering and research for the company, the model is the forerunner of vehicles gliding on air that could provide ground transportation at speeds of from 200 to 500 mph.

• • •

Rewarding careers are open to the sanitary engineer? To introduce science- and engineering-minded secondary school students to the tremendous career potential in health and sanitary engineering is the objective of *Your Career in Sanitary Engineering*, a recent brochure, prepared by the U. S. Public Health Service in cooperation with the Joint Committee for the Advancement of Sanitary Engineering. Faculty advisers, teachers, and others interested in personnel for an important—if often-overlooked—branch of the profession will want to see that the valuable little publication reaches the right audience. It may be purchased from the Superintendent of Documents (Washington 25, D. C.) for 25 cents.

• • •

A research program is aimed at ending pollution from car exhaust? The automobile industry has poured nearly $5,000,000 into a cooperative study to eliminate harmful materials from car exhaust. Proper engine adjustment will end most visible exhaust, the program finds. The solution to invisible exhaust—leading to air pollution in New York and smog in Los Angeles—is believed to lie in a device for burning hydro-carbons in the muffler with a flame or chemical catalyst. Charles M. Heinen, of Detroit, heads the technical committee conducting the program.

• • •

The index of bid prices for federal aid highway projects declined in the first quarter of 1958? On the basis of contracts awarded by state highway departments and reported to the Bureau of Public Roads, the decrease was 2.0 percent from the last quarter of 1957. With 1946 as a base year, the price index had risen from a low point of 125.5 in the second quarter of 1955 to 143.4 in the fourth quarter of 1957, a total increase of 14.3 percent. The index for the first quarter of 1958 was 140.4.

• • •

The Tennessee Valley Authority is twenty-five years old? It was in May 1933 that the bill authorizing development of the resources of the Tennessee Valley became law. The TVA has completely remade an 80,000-sq-mile area, replacing worn-out cotton fields with 360,000 fertilizer-enriched farms. A multi-purpose project, the TVA has built 20 dams and is operating 30 more, and provides a navigable channel of 11-ft depth for a distance of 650 miles. The largest generator of power in the world, the system has installed capacity of 10,500,485 kw—nearly half of it hydroelectric. It provides power for the two great AEC plants at Oak Ridge and Paducah, and for over 140 municipalities and cooperatives.

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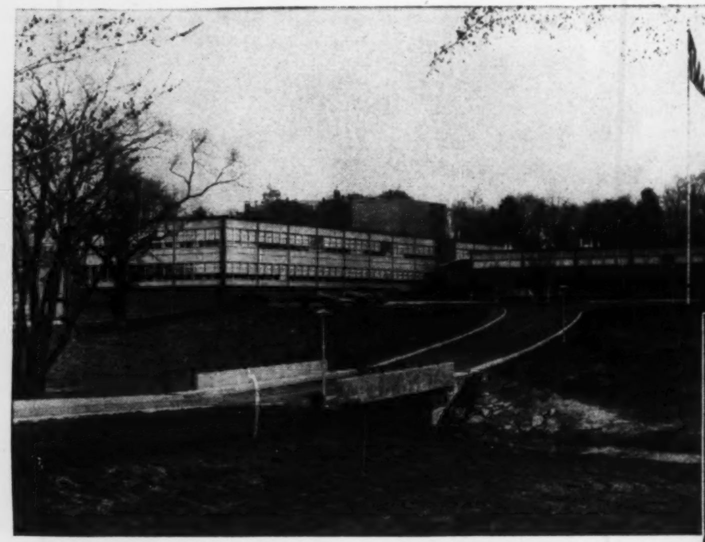

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CIVIL
ENGINEERING

Management has responsibilities to engineers

PAUL WAINWRIGHT, Chief Engineer, Hawaiian Dredging and Construction Co., Ltd., Honolulu, Hawaii

Unlike most other professional men, engineers generally are employees. This situation has created problems that have been the subject of panel discussions within the framework of ASCE at both local and national levels. The following article has been prepared from a program of the Hawaii Section on the general topic, "Raising Professional Standards and Improving Employment Conditions for Engineers."

It is doubtful whether a panel discussion conducted by any other profession would include this vital topic, yet I would guess that most readers of this article harbor definite opinions on management's responsibilities. This is true, of course, because there are a great many more engineers on payrolls today than there are doctors, lawyers, or architects. This single fact is one of the major causes of dissatisfaction, because management is very likely to feel that its responsibilities to an engineer are no different from those to any other person on its payroll.

If you were to ask an engineer employee and management to list the latter's responsibilities, you would find that each list contained the same items—but their interpretations would be vastly different. It is not my object here to reach any conclusion or to start a debate, but merely to help us approach the problem.

Our paychecks are a measure of our achievement—yours and mine. How has management arrived at the amount, which is usually in odd dollars? Most present-day competitive management has arrived at this figure because that is what comparable positions pay in the area. One of the tightest unions in the country is the so-called "union of the bosses." Most companies know what similar concerns pay their employees, at least up to a certain level, and that becomes the norm.

But that is no help to the engineer who feels he is underpaid, because if he changes companies, he will probably get the same pay. The engineer's viewpoint is that this norm is not equal to the compensation of other professional men in the area and that management, in setting engineers' salaries, has used accountants, purchasing agents, or even office boys as its basis for comparison.

Conditions of employment is the second of my four main responsibilities. Here we find the two points of view closer together. Such items as vacation, sick leave, retirement plans, and hospital plans appear to be desired by both management and the employee, although details and administration differ between companies. Job security comes under this heading and has been the subject of much controversy.

Management opinions differ with the type of business. Airplane manufacturers—who are building planes for the defense effort, and therefore subject to the whims of the military—do not feel that they are in any position to guarantee job security to engineers. The construction industry considers itself in the same position, while concerns like General Electric and Westinghouse can and do offer a measure of security. The engineer feels he is entitled to some advance notice, to severance pay based on length of service, and in general, not to be hired and fired like any hourly employee.

Communication is the third responsibility of management. By this I mean the flow of information from management to the engineer employee—such information as basic policies, responsibilities of the employee, and his opportunities. It is absolutely necessary that engineer employees be able to identify themselves with the organization. The engineer employee certainly expects that management will take him into its confidence as much as possible on its more important activities. He also wants to know where the ladder is that he can look forward to climbing—if he shows the necessary ability.

Management is sadly lacking in its general approach to this responsibility. Too many companies still have the opinion that their workers are robots. Many have limited communication and some are outstanding in this regard. As a firm gets bigger, the line of communication gets longer, and the problem more difficult. Thus engineers in big companies become "the engineering department," and too often the line of communication stops at the department head.

Lastly we come to professional status. All of us have had trouble here—from the patient explanation to our children that we do not drive trains, to the job of living down the Hollywood version of the engineer equipped with a campaign hat, riding trousers, and a transit.

To our plea for professional status, management's answer is a blank look, for truly it hasn't thought of engineers as professional men exactly, and I don't think it could tell you in what class it thinks they belong. If a recent survey is correct—that over 40 percent of those in management have been trained as engineers—then this reaction is hard to believe. The answer must be that these engineers have mentally disassociated themselves from the engineering group. It must be remembered that management is in business to make a profit, and every decision on its responsibilities to employees will be viewed economically rather than emotionally.

The engineer's point of view is simple and direct. He says, "I have spent a great deal of time and have worked hard to obtain an education in engineering. I expect to be treated as the professional man I am."

Bonding thin concrete to old

W. G. WESTALL, Airport and Highway Engineer, Portland Cement Association, Chicago, Ill.

Thin concrete has been successfully bonded to existing pavements at several U. S. Air Force bases. Repairs range from rehabilitation of pavement as much as 27 years old to correction of surface defects on newly laid work. Successful techniques have been developed for cleaning the old surface and bonding the new layer to it.

In August and September 1956, a thin bonded resurfacing course was applied to 47,000 sq yd of the aircraft parking apron at Selfridge Air Force Base, near Mt. Clemens, Mich. Approximately 37,000 sq yd of the project area consisted of 10-in. concrete 14 years old. The remaining area was 6-in. concrete 27 years old. The principal defects to be corrected by the resurfacing were surface scaling, raveling along the joints, and surface pop-outs over unsound pieces of aggregate. A considerable amount of random cracking, both transverse and longitudinal, was also in evidence.

Specifications required the placing of concrete resurfacing to a minimum thickness of 1 in. The first step was removal of all bituminous material from joints, cracks and other areas of the pavement. Joint cleaning operations were made difficult by an excessive amount of jet-fuel-resistant sealer, also by hot weather during removal and by the irregularity of the joints. This irregularity also made jointing of the resurfacing more difficult. Sealer was removed from the joints by plowing with an improvised "foot" mounted on the front of a light tractor, followed by two or more passes of a Tennant machine adjacent to the joints, and supplemented by hand-operated spud bars. The Tennant machine, equipped with a cutter head of 12-in. diameter revolving at 1,600 rpm, chips out a 4-in. path to a depth of about ¼ in. For final cleaning of joints after use of this machine, sand blasting was found to be effective.

Because of surface scale and excessive laitance in many areas, it was found necessary to scarify 80 percent of the pavement surface to provide a base of sound, clean concrete. Scarification was carried out by four Tennant machines. The debris created by the machines was removed by compressed air and by hand brooms to clear the immediate working area. A mechanical pick-up broom was used for final disposal.

It should be emphasized that an extremely rough surface is not necessary to secure bond. Scarification is used only to obtain a sound surface. Investigation by the Portland Cement Association (reported by Earl J. Felt in Highway Research Board Proceedings, Vol. 35, 1956) has brought out the fact that a slightly roughened surface, such as that produced by acid etching, is satisfactory for bonding the resurfacing. The acid treatment will be described presently.

On the Selfridge project, as is frequently the case on old concrete pavements, there were various substances on the pavement, where not scarified, that would be likely to cause bond failure. These included oil, grease, hydraulic fluid, bituminous materials, and paint markings. Paint and bituminous materials and the larger grease spots were removed by spot scarification. Areas not scarified were cleaned with a water-soluble commercial detergent.

Detergent powder (sodium metasilicate with resin soap) was applied to the wetted pavement surface at the rate of 1 to 2 lb per 100 sq ft with a hand-operated distributor similar to a seeder. The moistened detergent was then scrubbed into the surface with a mechanical sweeper and the surface flushed with water until it showed a neutral reaction to pH paper. Thorough flushing is necessary because the alkaline detergent, if it remains on the surface, will partially neutralize the acid subsequently applied for etching. Prior to acid etching, which is the final step in surface preparation, the pavement surface was cleaned by sweeping and blowing with compressed air.

Commercial muriatic acid (27.9 percent HCl) was delivered to the job by a tank truck equipped with a 12-ft spreader bar. A force pump on the truck supplied pressure for distribution. Delivery was regulated by the forward speed of the truck to give an application of 1 gal of acid per 100 sq ft on the wetted pavement surface. As soon as all visible etching or foaming action ceased, the pavement was scrubbed with a mechanical broom and flushed with water until it showed a neutral reaction to pH paper. Since a jell is formed if the acid is left long on the concrete, it is important to clean the surface by flushing and scrubbing as soon as foaming stops.

Several of the foregoing operations, as well as paving, must be scheduled and carried out simultaneously or in close sequence for good progress on a project of this size.

Paving was done in alternate lanes, using specially designed wood forms along each edge. Paving of the fill-in lanes (about half the pavement area) required no forms. The forms were made from 2 x 8 fir planks 14 ft long, surface dressed down to a thickness of 1¼ in. These forms were laid flat along each side of the paving lane, parallel to the old construction joints so that the 1¼-in. thickness provided the depth of the form.

Each form length had four steel flanges bolted to the bottom face and

pavements

Scaled and patched paving at Selfridge Air Force Base required resurfacing. Of 47,000 cu yd resurfaced, 37,000 cu yd consisted of 10-in. concrete 14 years old, the rest of 6-in. concrete 27 years old.

countersunk. The flanges extended 3 in. beyond the outer edge of the form and were bored to receive three bolts outside the form and one bolt through the form. Inner edges of forms were positioned immediately above the longitudinal construction joint and holes drilled in the concrete to receive lead expansion sleeves and lag screws for securing the forms to the old pavement. After the forms were bolted in place they were shimmed to line and grade with wood wedges. A steel strip ¼ x 2 in. was inserted into the longitudinal construction joint and tacked in a vertical position on the inner edge of the form to bound the paving lane and to prevent grout and concrete from running under the form.

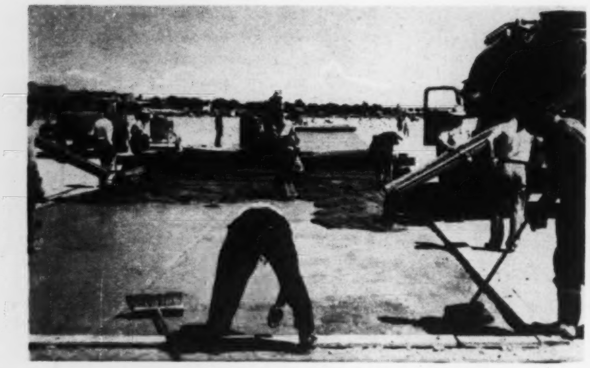
The wood forms used at Selfridge could not be considered an unqualified success. With occasional readjustment and additional shimming during construction, they did however provide an acceptably smooth surface. Recognizing the limitations of comparatively thin wood boards when used as forms, the U. S. Air Force has specified a minimum thickness of 2 in. for thin bonded concrete resurfacing. This 2-in. minimum, instead of the former 1 in., will raise the cost of material only slightly and will permit the use of steel channel sections for forms or of wood thick enough to have better rigidity.

After the forms were in place, the prepared surface was given a final cleaning. Any grease or oil from leaking equipment was removed with the Tennant machine. The pavement was then blown clean by the use of an air jet.

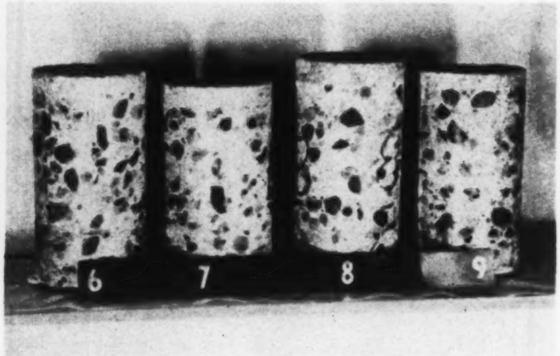
Just ahead of concrete placing, a 1 to 1 sand-cement grout, with plus ⅛-in. particles removed from the sand, was applied to the old pavement surface. The grout was mixed to the consistency of heavy paint in a paddle-type mixer, carried to the paving lane in buckets, and scrubbed onto the damp but not wet surface with rattan stable brooms. A coating of about 1/16 in. was left on the surface. Any excess grout in transverse and longitudinal joints was redistributed with a warehouse broom.

Tennant machine is used for cleaning joints and grinding surface. Its revolving cutter head chips out a 4-in. path to a depth of about ¼-in.

Bonding grout is carefully brushed in after concrete surface has been scarified or otherwise thoroughly cleaned, acid-etched, and washed.



Two transit mixers deliver concrete of 4-in. slump simultaneously to both sides of a lane. Forms are fastened to old concrete by lag screws.



Fifteen cores from Selfridge Air Force Base showed average bond strength of 323 psi between original concrete and resurfacing layer at top, characterized by smaller aggregate.

Hand methods of grout application were used on the Selfridge project because the proper pneumatic equipment, and the skilled operators needed for its operation, were not available. It should be mentioned, however, that the pneumatic method of placing bonding grout has been successfully used, but expert operation is required to control rebound and the accumulation of the coarser sand particles along the form lines in a concentration likely to prevent bond.

Ready-mix concrete was delivered to the site by transit mixers; two mixers were scheduled to arrive at the same time and place concrete simultaneously from each edge of the paving lane. Each mixer carried 5 to 6 cu yd of concrete made from crushed dolomite of ½-in. maximum size, 60 percent by weight of natural sand, and 7½ bags of portland cement per cu yd. Mixing water was proportioned to give a net water content of 5 to 5.1 gal per bag of cement and a slump of 4 to 5 in., which was necessary for discharge from the mixer and for placing and finishing of the resurfacing concrete. Sufficient air-entraining agent was added at the batching plant to produce an air content of 7 to 8 percent.

After a limited amount of hand spreading, the concrete was further spread during the first pass of a two-screed self-propelled finishing machine. The second pass with this machine struck off and consolidated the concrete to final grade. The finishing machine was equipped with offset rubber-tired wheels which traveled on the old pavement outside the forms. This arrangement worked quite satisfactorily since the wood forms were required to support only the buoyant weight of the screeds.

After the two passes of the finishing machine, the pavement surface was given a final finish with hand floats and straightedges. Surface texture was obtained with a burlap drag. A white pigmented curing compound, sprayed on, was used because it could be applied early to prevent the rapid loss of water and because it simplified subsequent joint sawing operations.

In placing bonded concrete resurfacing it is necessary to match the joints in the old pavement exactly, both in location and kind. Longitudinal and transverse expansion joints were formed in place using wood strips inserted in the joint crevice of the old pavement. These strips marked the location of expansion joints during paving and served as a filler in the finished resurfacing.

Transverse contraction joints were sawed with abrasive-type blades. The old joint locations had to be carefully marked on the side forms or on the surface of adjacent paved lanes, and a line snapped on the finished surface of the plastic concrete to mark the exact location for the saw cut. Sawing, which had to be done early to prevent precracking over joint locations, was carried out from 5 to 12 hours after paving, depending on the temperature and relative humidity. During cool weather the joints were sawed dry, which permitted earlier sawing with a minimum of raveling along the cut.

To meet the grade of the adjacent pavement, a 3-ft transition or ramp was built around the resurfaced area. The transition area was routed out to a minimum depth of 1 in. and the concrete for the ramp was placed by the same procedures as the other resurfacing. Planes enter the resurfaced area without difficulty.

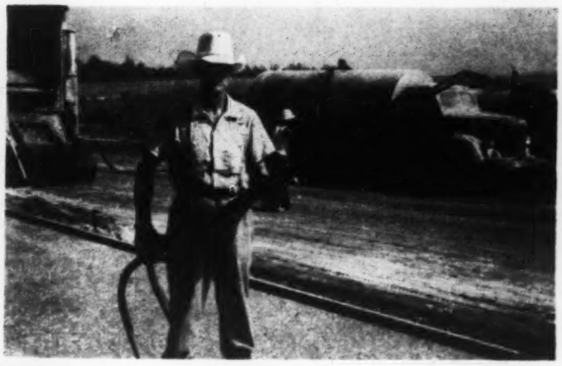
To check the thickness of the resurfacing and to secure specimens for testing the bond between the resurfacing layer and the old pavement, cores were drilled from the finished pavement. By its appearance, the resurfacing layer can easily be distinguished from the basic concrete. Fifteen of the cores showed an average bond strength of 323 psi when tested by shear stress in the laboratory. The investigations of Earl J. Felt, previously mentioned, led him to the conclusion that bond strength on the order of 200 psi is generally sufficient to insure adequate performance of bonded resurfacing.

After more than a year and a half of service, including the somewhat severe winter of 1956-1957, the resurfacing at Selfridge Air Force Base has a good performance record. Most of the random cracking of the old pavement has appeared in the resurfacing layer. However, the cracks are generally close and tight and have not required routing and sealing.

Resurfacing at Little Rock Air Force Base

Bonded resurfacing at the Little Rock Air Force Base was carried out early in October 1955, to repair the surface of concrete pavement placed several months before, which had frozen immediately after placing. About 700 ft of a 25-ft-wide pavement lane was damaged on the surface to a depth of about ½ in. The Army Corps of Engineers held the contractor responsible for replacing the damaged concrete, which was part of an aircraft parking apron 15 in. thick.

First the contractor broke out part of the concrete but this proved difficult and costly since the damaged area was on a fill-in lane bounded on both sides by concrete. An agreement was then reached permitting him to restore the rest of the pavement surface with a bonded layer 1 in. thick.



Ingenious air-water fog spray was developed to clean and dampen scarified concrete at Campbell Air Force Base. Clean sound surface is necessary for good bond.

Spalling along joints at Seymour-Johnson Air Base was corrected by sawing line 6 in. back from joint and removing concrete. Another 6-in. strip was removed where necessary.

Preparation of the pavement required scarification to a depth of 1 in. This scarification, on a fully matured slab with large-sized natural aggregate, proved tedious and relatively costly. A total of 575 lin ft of 25-ft paving lane, approximately 1,600 sq yd, was resurfaced.

No forms were necessary on the Little Rock project since the adjacent paving lanes bounded the work and provided grade and elevation for the finished resurfacing. The prepared surface was etched with muriatic acid by means of an improvised dispenser. This device was made by fastening a coiled plastic garden hose on a square of plywood which was equipped with a carrying handle. Three loops of hose on the bottom of the board were perforated and the acid was forced through the hose by a hand pump from glass containers mounted on the bed of a pickup truck. About 1 gal of acid per 100 sq ft was applied to the wetted pavement. Workmen equipped with goggles and protective clothing spread the acid over the pavement with push brooms. When the acid reaction ceased the pavement was scrubbed and flushed with water until it showed a neutral reaction to pH paper.

Placing of bonding grout and concrete followed the procedure described for the Selfridge Air Force Base except that the concrete was provided by a dual-drum job mixer instead of by transit mixers and that the two-screed finishing machine had two spud vibrators mounted on the front screed. The concrete was made from 45-percent crushed aggregate of ½-in. maximum size and 55-percent natural sand with 7¼ bags of cement per cu yd. The concrete had 8-percent entrained air.

Using standard metal inserts, the resurfacing joints were hand formed to provide continuity of joint openings through the resurfacing layer and the pavement base.

After more than two years of service, this section of thin bonded resurfacing shows no defects and is in fact indistinguishable in appearance from the adjoining pavement on the parking apron. This pavement has been put to a somewhat severe test by the 50,000-lb individual wheel loads of the jet bombers based at Little Rock.

Campbell Air Force Base

Parts of two hardstand areas at Campbell Air Force Base, Kentucky, did not meet surface and finish requirements and 1,400 sq yd was resurfaced with 2 in. of concrete in the summer of 1957. In one area it was necessary to scarify to a depth of only ⅛ or ¼ in.; in the other a 2-in. depth was removed to maintain the planned elevation. The methods followed were similar to those used at the Little Rock base.

Interesting details of the resurfacing work at the Campbell base and at the Seymour-Johnson Air Force Base at Goldsboro, N. C., are shown in accompanying illustrations.

Method proved feasible

Resurfacing or patching of concrete pavements with bonded concrete has been proved feasible in both laboratory investigations and field construction projects.

When the purpose is only to even up rough surfaces, a thin resurfacing layer will perform as well as, and in many cases better than, a thicker slab, provided that adequate bond is obtained between the old and the new concrete. In many cases, especially when the concrete to be resurfaced is part of a larger area, a thinner overlay avoids the problem of adjusting grades on the perimeter of the resurfaced area.

The performance of resurfacing or patching with concrete depends upon the two surfaces. If the essential operations are carried out on a clean sound surface, with good workmanship and high-grade materials, the adequate and uniform bond essential to satisfactory performance can be obtained.

Trial mixes recommended for this resurfacing

	THICKNESS OF RESURFACING			
	½ in.	1 in.	2 in.	3 in.
Cement content	94 lb	94 lb	94 lb	94 lb
Total water*	42 lb	42 lb	42 lb	42 lb
Fine aggregate†	190 lb	170 lb	190 lb	180 lb
Coarse aggregate:				
Maximum size	⅜ in.	½ in.	1 in.	1½ in.
Amount†	115 lb	170 lb	230 lb	305 lb
Air content	9 to 11%	6 to 8%	5 to 7%	4 to 6%
Cement factor, approx.	8.5 sacks per cu yd	7.5 sacks per cu yd	7.0 sacks per cu yd	6.3 sacks per cu yd
Slump	1 to 4 in.	1 to 4 in.	1 to 4 in.	1 to 4 in.

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*Including free moisture in the aggregates.

†Based on saturated surface-dry aggregate, with a specific gravity of 2.65.

"Available knowledge grows at a snail's pace while our need for it races at fantastic speed."
—M. A. Mason.

MARTIN A. MASON, M.ASCE

Our professional responsibility--

During recent months not one authoritative statement on the status of American science and engineering has come from the engineering profession, so far as I am aware. Columnists, Congressmen, commentators—almost everyone who knows little or nothing of the true state of American engineering—have discoursed learnedly or otherwise on the subject. But the engineering profession itself has remained silent.

Some comments have appeared in the technical press, it is true, but we must remember that of the 130 million Americans who can read, only some 250,000 engineers are familiar with these engineering publications. The public in general knows nothing of science or engineering at first hand, and gains what it does know primarily from newspapers, magazines, radio, and television. These are the people whose needs and desires the engineer professes to serve, or to dictate, as the case may be. These are the people who, in one way or another, supply the money and the need for defense, for public works, for industrial enterprise, and the whole complex of engineering activity.

Presumably the 250,000-odd engineers of the nation are vitally concerned that these clients should be adequately served and competently informed about engineering. Presumably the public takes it for granted that the engineering profession is aware of what it needs to know, and is aggressive and untiring in its efforts to obtain this needed knowledge. Such needed knowledge comes, of course, from research and study; it becomes part of the profession's contribution to human progress through publication and use in engineering practice.

If we look at the technical publications of the engineering profession, we find much information, of more or less value, on technical details, but we search in vain for the important presentation of significant new knowledge we hope to find.

In fact, much that appears in popular mediums cannot be found in the technical press. For example, where did you see the outline design of the Vanguard or Jupiter-C missiles, or first read of the "area-rule" in aerodynamics, or find the problems of "re-entry" exposed, or discover that "exotic" fuels were not concoctions of papaya juice and alcoholic spirits, properly compounded. The point is obvious—if the engineering profession is not publishing new knowledge and expanding the frontiers of engineering, then it must be presumed that as a profession it has no such knowledge or is not concerned with it.

"This odd spectacle of a profession mute on matters about which it is presumed to be expert is serious. It not only contributes to the assumption that the engineering profession is not competent, but it also creates an atmosphere in which anyone who chooses can assume the status of expert. . . ."
—M. A. Mason.

Member of ASCE Committee on Research; Dean, The School of Engineering, George Washington University, Washington, D.C.

development of new knowledge

Recently Americans generally and the engineering profession in particular suffered a rude shock. People suddenly became frightened because an unfriendly neighbor nation achieved an engineering feat before we did. And now they are concerned about American science and engineering in general. Political figures, gossip columnists, admirals and generals rush to fill the press and the air with pronouncements, palliatives and proposals. The fact that some of these individuals talk without benefit of knowledge does not prevent the public from coming to conclusions on what it reads and hears. Those who can speak with knowledge remain silent.

This odd spectacle of a profession mute on matters about which it is presumed to be expert is serious. It not only contributes to the assumption that the engineering profession is not competent, but it also creates an atmosphere in which anyone who chooses can assume the status of expert—whether he is in control of a missile development program without understanding the simplest elements of rocket mechanics, or whether he learns the technical terms he uses five minutes before he pontificates on the state of science and engineering in the United States.

That expensive but pleasant weapon of mass destruction, the modern automobile, has been eagerly accepted by the American public from the hands of the engineer. Yet this same public now is shocked into the belief that the American engineer is not as smart, well-educated, or competent as his Russian counterpart. Some engineers share this untrue and unhappy view, and both groups wonder about the state of American science and engineering. The bulk of the engineering profession, possibly aware of the truth, says nothing.

The typical first reaction of the uninformed is to place blame. Happily an obsolete, incredibly poor educational system, from which almost all vestiges of real intellectual development had been swept, was handy for the purpose. As a result it appears that many billions of new dollars may follow down the drain the many billions of old dollars already wasted. The boondogglers of the Rooseveltian 30's could not surpass in their wildest dreams the colossal stupidity of some of the programs bruited about for the discovery, encouragement, fostering, and coddling of those having scientific and engineering talent.

As any competent engineer or scientist knows, he is what he is because of a driving force he cannot resist—the need to know and to create. We are engineers because we are driven by a compulsion that is not subject to government programs or board of education regulations. God in his great wisdom has afflicted only a few with this burden, and man in his lesser wisdom has denied many of these few the opportunities for development they need. Yet so long as some have or make the opportunity to satisfy their need for creative knowledge, so long will America have scientists and engineers competent to satisfy its needs.

We have today the quality, and nearly the quantity, of engineers and scientists we need, but the bonds with which they are fettered have almost made them impotent. Most engineers are employees who do what they are told to do. They have very little opportunity for excursions of discovery into the vast unknown, the desire for which made them engineers in the first place. Their creative ideas soon become buried under a mountain of deadlines, competitive production, military directives, security classification, company policies, and economic necessity. The ideas still occur but they do not often germinate in the sterile atmosphere of engineering today. And so the river of ideas that could be becomes the trickle we know. Available knowledge grows at a snail's pace, while our need for it races at fantastic speed, set by our friendly and unfriendly neighbors.

The engineer—probably unsurpassed as an organizer of forces, materials,

> ***"In our society the individual engineer or scientist is almost powerless to act alone. He doesn't know how to gain the support he needs; he can't or won't speak a language that millions of non-engineers can understand; he believes his economic situation as an employee is precarious. In short, he decides to store his ideas in the confines of his own mind at the slightest sign of opposition."***
> **—M. A. Mason.**

and men—has not assumed the responsibility for the development of knowledge that he alone can assume. He alone can assume this responsibility because he alone is capable of evaluating the new ideas, competent to develop them, and skillful enough to carry them to fruition.

But in our society the individual engineer or scientist is almost powerless to act alone. He doesn't know how to gain the support he needs; he can't or won't speak a language that millions of non-engineers can understand; he believes his economic situation as an employee is precarious. In short, he decides to store his ideas in the confines of his own mind at the slightest sign of opposition. It is my belief that the profession as a whole, and particularly the technical societies, must act to correct this situation by supporting the efforts of individual engineers who make up the profession.

Allow me to paraphrase here some ideas from a thought-provoking editorial in the professional news magazine *Geotimes,* published by the American Geological Institute.

> ***Is engineering asleep at the switch?***
>
> ***In this Sputnik-stimulated era of scientific awakening the engineering profession seems to be just rocking along. Politicos, the military, and government are driving the scientific bandwagon and the profession seems content to leave the driving in these inexperienced but aggressive hands. Answers to some leading questions might tell why.***
>
> ***Do we present, and support, a united professional front as engineers, regardless of specializations and employers?***
>
> ***Is the profession doing an effective job in creating public awareness of the nature and importance of engineering?***
>
> ***Is the profession effectively working to insure oncoming students educational opportunities and standards adequate to satisfy the needs of the nation and the profession?***
>
> ***Has the engineering profession defined and vigorously supported realistic procedures for secrecy classification that will not impede the development of needed knowledge?***
>
> ***Has the profession defined the frontiers of engineering and is it vigorously attacking these frontiers?***
>
> ***Is the profession dynamically widening the horizons of engineering applications?***
>
> ***Dependent as the profession is on research, why is there so little support for research by the technical societies of the profession?***

Many more such embarrassing questions may be posed, the answers to which, as to those stated above, I believe must be in the negative.

I have chosen these questions in preference to others because I believe they highlight an almost total lack of acceptance of responsibility by the profession for the development of new knowledge. I am convinced that the profession, if it is to deserve the name, must take positive and effective action in each of these areas. We must develop public understanding and support; create in engineering practice conditions favorable to the origination and development of new ideas; insist on educational opportunities for young people to mature intellectually as their talents dictate; and provide vigorous, generous support, through the technical societies and other professional groups, of research holding promise of increasing our knowledge. A profession that does less has no claim to the support of the public or the nation. A professional group that does less offers the individual not much more than a craft union—and that without economic benefits.

This responsibility is well recognized and has been since the professional societies were founded. In their charters and articles of incorporation will be found in almost every case the words, "advancement of knowledge" or words of similar intent. Our tax position is influenced favorably by this avowed purpose. Our literature seldom fails to cite this lofty objective. Yes, we recognize the responsibility, but apparently we have few scruples about neglecting it. Our societies are not at all reluctant to leave this responsibility to individuals, to the Government, to private industry, in fact to anyone. Have you read the financial reports of ASCE and discovered that not a single penny of its income is expended on specific basic or applied research with the purpose of expanding the frontiers of knowledge or widening the application of the pitifully little we know?

Let me quote from an article in the April 1958 issue of CIVIL ENGINEERING (pp. 64-67) by Gene M. Nordby, A.M. ASCE, and R. N. Faiman entitled "NSF Promotes Basic Research in Civil Engineering."

> ***"Most engineers of this country would be surprised and somewhat taken aback if they were told that they as a group had been negligent in promoting their share of basic research. . . . But it is true there has been apathy toward basic research, not only in civil engineering but in all engineering and even in some areas of the pure sciences, including physics and chemistry. . . . This situation is especially critical in the engineering fields since physics and chemistry have almost deserted those classical fields on which engineers are dependent as a foundation for their development and design work.***
>
> ***"Basic research is one index of a nation's scientific progress. Yet this nation has been largely dependent upon research in Europe. Although in the long run, basic research pays off in the most practical terms, nevertheless direct and immediate links between it and its applications are extremely rare."***

I plead with you to insist that our societies begin to take the position of leadership they should assume. If the societies cannot get together and speak for the profession with one voice, respected and listened to by the public and the Government, let us bend our efforts toward the realization of that aim. Let the professional groups take the lead away from the news columnists and government officials in matters of concern to the nation involving science and engineering on which they can speak with authority.

Let us, our societies and ourselves, as responsible professionals go into our community councils and the Congress with constructive proposals for providing in our primary, secondary, and college education the means of developing disciplined minds, whether they be destined for the law, the arts, or the sciences. Let us insist that our societies give substantial support to the development of new knowledge. On this the future of our profession as well as of Western civilization depends.

Our duty is clear before us. If we know whereof we speak—and like you I believe that we do—then we must lead and not follow. Not only as a profession, but also as individuals, we must press forward the frontiers of knowledge. We must encourage that most ephemeral and elusive of all human qualities—original creative thought. As a profession we should be, as many individuals are, constantly dissatisfied with what we know because of the much wider knowledge we lack. As a profession we should take the lead in searching out the new knowledge lying all around us, only awaiting discovery. If we cannot or will not do these things we must be honest enough not to claim the confidence of those who depend on us for these things.

(This address was originally delivered at the ASCE Chicago Convention Luncheon, sponsored by the ASCE Committee on Research, with its Chairman, Elmer K. Timby, presiding.)

BINGHAMTON
DEPARTMENT OF
PUBLIC WORKS

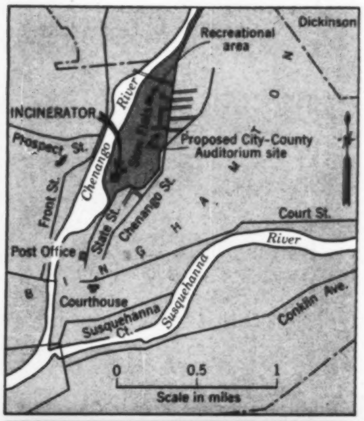
Binghamton's 300-ton incinerator (left) occupies site of old garbage dump (see map). Odor and stack ash are so controlled that users of nearby recreational facilities are not disturbed. Crane operator (lower left) has unobstructed view in loading twin circular furnaces, which are stoked by hand (bottom left).

LEONARD S. WEGMAN, A.M. ASCE

Leonard S. Wegman Company,

Consulting Engineers, New York, N.Y.

Binghamton's incinerator after one year



Built at a cost of less than $3000 per ton of rated capacity, the 300-ton municipal incinerator for Binghamton, N.Y., offers a number of interesting features in design development, operation, and effect on adjacent property.

Binghamton, largest of Broome County's industrial Triple Cities, had a 1952 population of 82,000, which produced an estimated annual total of 29,000 tons of refuse consisting of garbage, rubbish, and commercial waste. All this was dumped in Stow Flats, an area of about 75 acres lying behind the Corps of Engineers dike on the east bank of the Chenango River which was rapidly being filled in. Stow Flats is within three-quarters of a mile of the central business section, and the dump area, although well operated, left no doubt as to its presence. See Fig. 1 at left.

When the city administration decided to eliminate the dump it requested the writer's firm to review several earlier reports on the problem and to make recommendations on an incinerator to serve the city. To establish design criteria, each of the following had to be studied:

1. **Site.** This involved the location, in relation to existing collection routes and to a projected recreation center in the vicinity; the topography of the site and access to it; and subsurface conditions.
2. **Plant capacity.** This included the population trend in the service area, the per capita production of refuse, and initial and future operating schedules.
3. **Plant type and cost.** Aspects studied included operator training requirements, comparable experience records, control of stack effluent, and unit volumes and velocities.

Site selection

Besides eliminating the nuisance of the dump, the city wanted to develop Stow Flats into a recreational center, thereby upgrading the surrounding area and taking advantage of the 3,500 ft of frontage on the Chenango River. At the same time an almost ideal site for the new incinerator was found in the southwest section of Stow Flats. This location was objection-proof as the site of a new refuse utility. No one could validly object to a use for the existing dump which meant elimination of raw refuse without change in collection routes.

Topographically the site is high and roughly level in the plant area and low in adjacent areas, which will be capable of receiving incinerator residue for many years to come. It is central to the city's area, thereby assuring minimum collection costs. It has the advantage of being on the river bank so that the dumping side cannot be seen from adjoining areas.

Against these important advantages were weighed the possible hazards of a poor stack effluent which would hinder recreational activities in the adjoining area. Also, the preliminary subsurface investigation revealed that exceptionally deep piling would be required through the loose fill. In view of the stage that had been reached at that time in the control of incinerator stack discharge, the designers advised the city that the effluent, while it would not be entirely free of fly ash, would not preclude the contemplated use of the adjacent area for recreation.

Foundations posed a problem. Borings disclosed that for 30 ft below grade the garbage fill had practically no capacity for bearing or lateral support. Below the 30-ft level, and extending to the 100-ft level, the predominant material was silt except in the southwest corner of the site, where good bearing was indicated at 60 to 70 ft below grade, and at the easterly end, where adequate bearing could not be anticipated above the 120-ft level. Subsurface profiles indicated that the proposed plant site was on the bank of a former course or branch of the Chenango River, which accounts for the wide divergence in character of material across its 160-ft width.

Preliminary calculations indicated that 16,000 lin ft of piling would be required, at a unit cost of \$5 per lin ft, or a total of \$80,000. It was assumed that some piling would be needed at any other site that might be chosen, plus more difficult excavation and higher access-road costs. Therefore, for the purpose of comparing costs, a sum of \$50,000 was selected as representing the excess foundation cost at the Stow Flats site. The annual vaue of this excess was then compared with the annual dollar effect of a change in collection routes necessitated by a new site, utilizing the following equation:

$$D[T \times M \times (Cv + Cl)] - Cf = Sa$$

where $D = 260$, working days per year
$T = 40$, average number of trips per day by city-owned trucks
$M = 4$, average additional round-trip mileage per truck trip for nearest alternate site
$Cv = \$0.10$, estimated vehicle cost per vehicle-mile
$Cl = \$0.15$, estimated labor cost per non-stop vehicle-mile
$Cf = \$3{,}250.00$, estimated annual debt service on assumed excess foundation cost of \$50,000
$Sa =$ annual advantage in dollars of Stow Flats site

Then $Sa = 260[40 \times 4 \times (0.1 + 0.15)] - 3{,}250 = 7{,}150$

The indicated saving of \$7,150 annually conclusively proved the overall advantage of the Stow Flats site.

Plant capacity

Possibly the most important design element in an incinerator is the anticipated plant loading and the appropriate plant capacity. Too little capacity results in higher labor charges and overuse of equipment. Too high a capacity results in needless capital investment. Plant loading is a function of population and per capita refuse production. The Broome County Planning Board developed a 1970 population estimate of 85,000 for Binghamton and the population curve projected to 1985 indicated 88,500. If the design capacity year is taken as 1985, with a population base of 90,000, optimum use should occur in that year, with increasing use to the end of the 30- to 35-year anticipated useful life of the facility.

Other than the knowledge that per capita production of refuse is rising there are no precise guides to this factor, and probably never can be any, as referred to a specific period in the future. With continuous changes taking place in habits and standards of living as well as in techniques of manufacture and distribution which greatly affect the commercial production of refuse, it is not possible to predict anything more accurate than a general trend. Similarly an incinerator service area cannot be as sharply defined as a sewage or water supply district for example. Short of a costly permit system, deliveries of commercial and industrial refuse cannot be limited to establishments within the specified area.

A review of previous reports made for the city and a comparison with the then available standards showed an indicated production of approximately 0.35 tons of refuse per capita per year. For a population of 85,000, the indicated plant loading would be 29,750 tons per year.

With the anticipated range of annual tonnage established, the next steps are to select burning schedules to conform with a 40-hour work week, to coordinate collection operations, and to place limits on the time between shut-down and start-up. This last factor requires a balance between a reasonable allowance of time for occasional furnace-brick replacement and other interior maintenance, and avoidance of too long a period between firings, which might result in excessive and undesirably wide temperature fluctuations.

Table I shows the various volumes that can be handled under different burning schedules. Since the expected loading was to be approximately 30,000 tons, and the second schedule, 5 days at 10 hours, seemed to strike a suitable mean between compliance with each of the operating criteria for initial and future years, the 300-ton capacity was selected, as shown in bold-face type. Note that the nominal, rather than the actual furnace capacities are used. Nominal capacity—the manufacturer's rating—presupposes an optimum operating schedule, burning rate and temperature; an acceptable stack effluent; a certain small proportion of unburned combustibles in the residue; and limiting proportions of refuse ingredients. These conditions offer a reasonable basis for selecting capacity. Actual capacity may run from 5 percent more to 15 percent less than nominal.

Type and cost of plant

In choosing the type of plant, the prime criteria included cost of construction and operation, required oper-

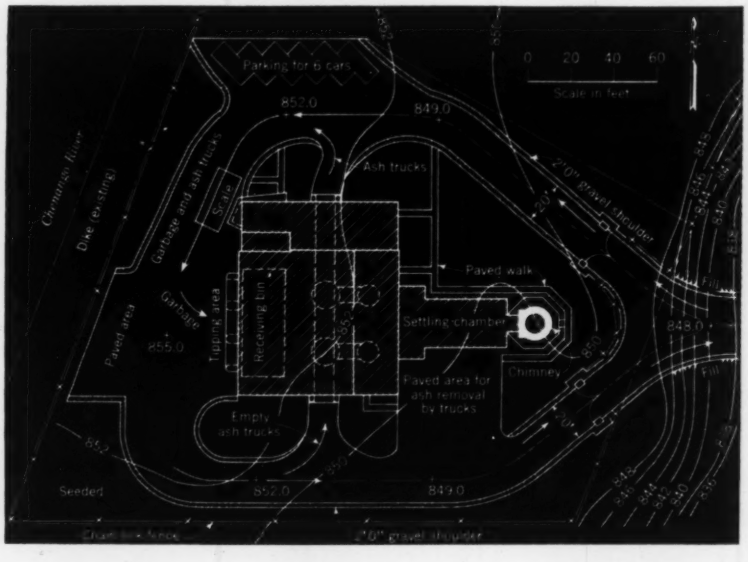


TABLE I. Annual capacity, in tons, by weekly burning schedules

Nominal Furnace Capacity	Burning Schedules			
	5 da @ 8 hr	5 da @ 10 hr	5 da @ 12 hr	5 da @ 16 hr
200	17,300	21,600	26,000	34,600
250	21,600	27,000	32,500	43,200
300	26,000	**32,500**	39,000	51,800
350	30,300	37,900	45,500	60,500

ator skills, record of experience with the equipment, and character of stack effluent. Cost limitations set by the designers were a construction cost of $3,000 per ton of rated capacity and an operating cost under $2.50 per actual ton burned. Consistent with these cost limitations, a minimum of operator skills would be required, which would mean a minimum of mechanical devices for the initial years. Since this was to be Binghamton's only incinerator, the plant type had to be one with a well-proved record of successful operation under like capacity. For a municipality, it was desirable to obtain competitive bidding on the equipment.

All the above criteria appeared to be satisfied by a crane-and-bin type of incinerator utilizing two circular, mechanically stoked furnaces of 150-ton nominal capacity.

Binghamton's smoke ordinance limited color to Ringlemann No. 2 but there were no legal limitations on fly-ash discharge. Nonetheless, with the projected recreational use of nearby land in mind, substantial fly-ash removal from the effluent was essential. Fly ash was to be settled by subsidence in a settling chamber, arranged for rapid daily removal of accumulations. The chamber was to be made large enough so that a more effective mechanical entrapment system, incorporating hydraulic settling and induced draft, could be installed later if such more effective removal should prove to be necessary.

Design and construction

Layout of the site, Fig. 2, achieves good orientation by placing the truck tipping and discharge operations on the river side, away from the recreational area planned for the north and east sections of the site. The relative isolation of tipping operations justified the economy of eliminating housing over the tipping area, also permitting faster and safer truck movement. All truck turns are to the left, where the driver has his best side vision. The weighing scale is directly on the traffic flow line, and the weighmaster's office and observation booth are an integral part of the main incinerator structure. An offset side window allows the weighmaster a controlling view of the truck tipping area.

For best operation, a crane-and-bin plant is ideally placed on a side-hill plot. This plot was rather flat, but the ease with which the garbage fill could be excavated and regraded partially compensated for the lack of a side hill (Fig. 2). An increase in the building height permits residue trucks to pass under the furnaces. Fly ash and other accumulations are removed manually from the compartments in the settling chamber and chimney base, and then loaded directly into a truck which can park alongside the access doors. The chimney was placed far enough away from the main plant so that it will be easy to install any mechanical effluent-improvement system that may be developed and deemed necessary in future.

A cross section through the furnaces and stack is shown in Fig. 3. For maximum economy the building envelope is cut back over the combustion chambers and the office wing. The settling chamber is in its own wing.

Building and operating features

At the tipping apron, the curb of the receiving bin is beveled to permit the load-packer type of truck to be discharged and still leave a safety vertical curb with a horizontal face, on which a man can stand for observation.

The canopy protects the bin sufficiently against the entrance of rain. To protect the concrete from bucket impact, steel rails are imbedded, with their bases flush with the surface, in the bin sides and bottom. The beveled face at the bottom of the bin wall serves to bring the refuse at the side of the bin directly under the bucket when it is dropped vertically. This compensates for the limit placed on bucket side-travel by the clearance requirements of the crane-rail support and makes it unnecessary for the operator to "throw" the bucket laterally.

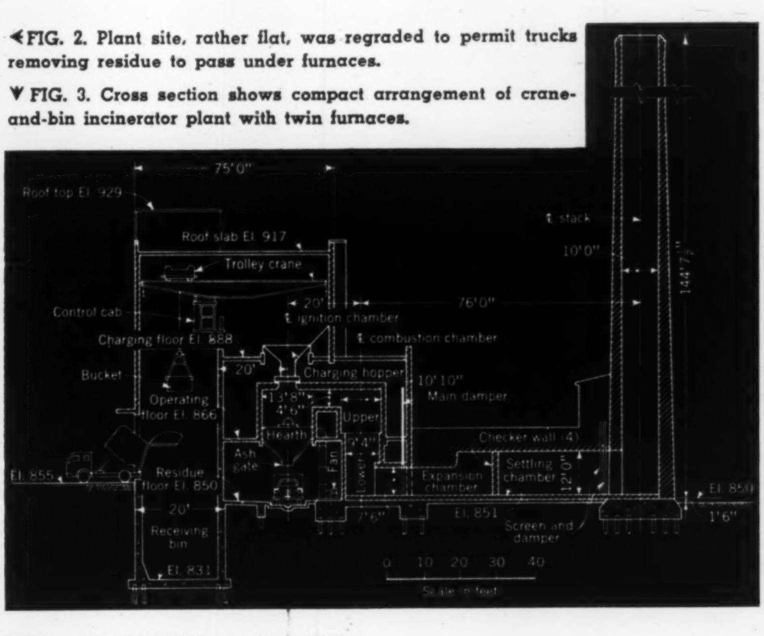
Crane operation

Considerable thought was given to the crane operator's field of vision from his cab. The crane cab was revised by the manufacturer at the designer's suggestion to provide a clear glass section in the cab floor, along with clear glass panels on the offset sloped right wall. Now the operator has a completely unobstructed view of the bin and the dumping doors without rising from his seat. In the course of an 8-hour duty, the operator may be required to perform as many as 200 cycles, each consisting of traveling to a bin section, dropping the bucket, closing on a load, hoisting, traveling longitudinally, shifting the bucket laterally and unloading into the charging hopper. Some economy in crane-movement time is achieved by extending the rear apron on the furnace charging hopper, thus reducing the lateral accuracy necessary for positioning the bucket for unloading.

General building facilities

Incinerator operation is under the direction of a superintendent, whose office is on the second, or operating floor of the plant in the office wing. His office lies directly above the weighmaster's, to give the superintendent the best vantage point, from which he

◀ FIG. 2. Plant site, rather flat, was regraded to permit trucks removing residue to pass under furnaces.



▼ FIG. 3. Cross section shows compact arrangement of crane-and-bin incinerator plant with twin furnaces.

can view, in turn, the approaching trucks, the scale platform, the tipping area and the operating floor, visible through a large glass panel. With a window-mounted mirror, he can readily observe the stack effluent. Dual temperature recorders are also in the superintendent's office. The crew's locker, toilet, shower and lunchroom occupy the remainder of the second floor of the office wing, and the lunchroom is equipped with a cabinet-type combination kitchen unit. Crew's quarters are a matter of some pride to the staff, and this is aided by the provision of separate toilet facilities for truck drivers—in an alcove at the tipping-area level, accessible from the outside through a door adjacent to the first dumping bay.

A gas-fired furnace, located in the rear half of the first floor of the office wing, provides heat and hot water for the building. Considering all the heat generated in the daily burning of over 200,000 lb of refuse, it would seem that a separately fueled building furnace could have been dispensed with in favor of a waste heat boiler. However, the need for building heat before start-up time and during servicing periods would have required a dual-operation furnace, partly fueled and partly utilizing waste heat. Such an arrangement was rejected in line with the decision to avoid, wherever possible, devices needing periodic readjustment and servicing.

Structure

As has been mentioned, the foundations were rather costly as compared with the rest of the structure. Specifications permitted several types of cast-in-place concrete piles encased in steel shells. The contractor elected to use a fluted shell, driven without mandrel, and filled with concrete after driving and interior inspection, done by the Union Metal Pile Company. Piles were driven with a single-acting steam hammer, delivering 15,000 ft-lb per blow, to a capacity of 40 tons based on the ENR formula, provided the depth attained at the indicated capacity was consistent with the subsurface boring information. As anticipated, pile lengths varied between 50 and 120 ft. Bending strength in the layer of garbage fill, which was presumed to have very little lateral support capacity, was provided by a cage of reinforcing steel inserted into the upper part of the shell before concreting of that part.

The entire exterior, except for the settling chamber, is of face brick, and the same brick is carried through to serve as interior finish. Concrete walls are painted and walls in offices and crew's quarters are glazed tile. The frame is structural steel, fireproofed throughout, except for the exposed roof beams.

In line with current practice, color is used liberally throughout the plant. Deep turquoise is used for exterior doors, sun yellow and aluminum for metal stairs and walkways. Interior columns are sun yellow; ceilings are white; furnaces are bright orange and black; electrical equipment is a delft blue; and fire equipment is chinese red. Other equipment and interiors are appropriately varied as to color. The entire plant presents a bright and cheerful aspect, which is conducive to a high level of maintenance control.

Furnaces and appurtenances

The twin furnaces are circular, mechanically stoked units, each with its own charging hopper, electrically operated charging gate, residue hopper, hand-operated residue gate, flues, and combustion chamber. Gases from the combustion chamber discharge into a common settling chamber. Auxiliary fuel is not used. Dampers are arranged so that one furnace can be repaired without interfering with the operation of the adjacent furnace. Principal dimensions of each furnace unit are as follows:

Horizontal area of hearth, 148.5 sq ft
Nominal burning rate, 84.0 lb per hr per sq ft
Volume above grates, 10.3 cu ft per ton per 24 hr
Charging hopper area, 144 sq ft
Charging hopper depth, 8 ft, lip to gate
Charging hopper throat, 4 ft x 4 ft
Residue hopper, 2.3 cu ft per ton per 24 hr
Quenching, 35 gpm per furnace
Height of residue gate above driveway, 10 ft 9 in.

Each furnace is equipped with a forced-draft fan and a hearth-cone cooling-air system. Rotating units consist of a motor-driven cast-iron cone, 3 ft 6 in. in base diameter by 2 ft 9 in. high, with three projecting arms 12 in. long. Recording pyrometers are provided along with audible high-temperature alarms. Three 12-in. x 18-in. over-fire, manually-operated air doors admit air when the operating temperature exceeds the limit of 2000 deg F. The refractory is 9 in. of super-duty fire brick with 4½ in. of insulating brick encased in 3/16-in. steel plate. Dumping grates are at present hand operated from eight points on the furnace circumference, but hydraulic operation is under consideration.

The ignition chamber of each furnace is connected to its combustion chamber by a refractory-lined overpass flue, 4 ft 6 in. high by 7 ft 10 in. wide by 7 ft 9 in. long at its centerline, providing an area of 0.235 sq ft per ton per 24 hr.

The combustion chamber is circular, the upper section 12 ft 3 in. high by 10 ft 10 in. in diameter, the lower section 17 ft 7½ in. high by 9 ft 4 in. in diameter, connecting with a lower discharge flue 7 ft 6 in. high by 7 ft 0 in. wide by 12 ft 0 in. long. Exclusive of flue sections, each combustion chamber has an effective volume of 16.7 cu ft per ton per 24 hr. Refractory lining is the same as for the furnaces. A 3-ft x 4-ft access door on the residue-driveway side of the chamber allows the chamber to be used as a crematory for animal disposal and also as a clean-out for trapped ash.

Settling chamber

As noted earlier, it was important to achieve a good stack effluent, with a low fly-ash content, without dependence on the then unproven methods of mechanical entrapment. The designers elected to use a large settling chamber, of steel and transite construction, refractory lined and arranged for quick removal of accumulations. Gross length, including expansion chambers, is 47 ft 9 in. x 22 ft wide and 12 ft high, yielding a volume of 12,600 cu ft, or 42 cu ft per ton per 24 hr. Four clean-out doors are provided and there is a checker wall between each pair of doors. The lower 2 ft of each checker wall is solid, the next 5 to 7 ft consists approximately 50 percent of openings, and the upper 3 to 4 ft is left open. Brick in the intermediate section are set at angles to introduce some horizontal curve in the gas flow; the resulting small centrifugal action contributes to increased ash drop-out.

Chimney

The single chimney is 145 ft high, with a constant inside diameter of 10 ft and an outside diameter varying uniformly between 17 ft 6 in. and 12 ft 10 in. The chimney is equipped with a steel corset, refractory lining, lower target wall and air-ventilated base. A manually operated damper connects with the settling chamber.

Bids were taken in early 1955 on the furnaces, equipment, chambers and appurtenances, so that the structural design could be based on a specific furnace assembly. Alternate prices were taken at the same time on a mechanical ash entrapment system, but the designers recommended that such a system was not necessary initially, and the alternate was not accepted. After award and sufficient development of the furnace details, bids were taken on the plant proper late in 1955.

Contracts were divided into general and mechanical trades, with a separate chimney contract, for a total of six prime contracts. Construction was completed in December 1956. Construction conditions were satisfactorily

TABLE II. Payments to contractors

Contract	Contractor	Item	Cost	% of Total
No. 1	Morse Boulger Destructor Co., New York, N. Y.	Furnaces & appurtenances	$299,276	33.7
No. 2	Vincent J. Smith, Inc., Binghamton, N. Y.	General constr.:		
		Piles	70,687	7.9
		Structure & site	421,143	47.5
No. 3	International Chimney Corp., Buffalo, N. Y.	Chimney	37,893	4.3
No. 4	J. & K. Plumbing & Heating Co., Inc., Binghamton	Plumbing	34,601	3.9
No. 5	A. R. Greene & Sons, Binghamton, N. Y.	Heating	9,094	1.0
No. 6	E. A. Davis, Binghamton, N. Y.	Electrical	15,067	1.7
		Total	$887,761	100.0

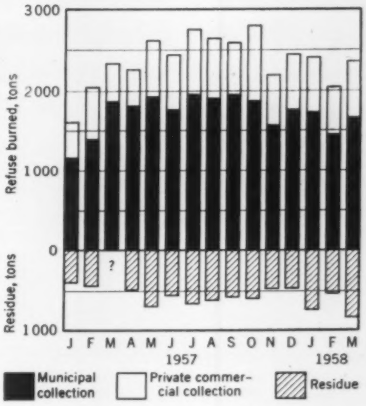


FIG. 4. Tonnage of refuse collected and burned and tonnage of residue are shown by months since start of operation of Binghamton Incinerator.

anticipated in the plans and specifications. This, coupled with the adroit coordination of all six skilled and cooperative prime contractors, resulted in final payments to the contractors, given in Table II, being within one half of one percent of the bid prices.

Plant operation

Operation was begun on January 14, 1957, under the direction of the furnace manufacturer. These tests demonstrated compliance with specification requirements as to operating temperature, capacity, 3-percent limit on unburned combustible refuse in the residue, and maintenance of better than Ringleman No. 2 smoke color in the stack effluent.

Monthly refuse receipts at the plant are shown in Fig. 4. The city-owned trucks carry about 2.5 tons per load and the privately owned trucks, hauling commercial and industrial refuse, average less than 0.3 tons per load. Total annual volume, from February 1957 to January 1958 inclusive, was 29,260 tons, which showed reasonably close agreement with the estimates made during design. If the 1957-1958 population in the service area is taken at 83,000, then the actual loading per capita is 0.352 tons per year. An indication of the sanitary value of this incinerator is the fact that nearly 2,000 dead animals were disposed of by cremation in the combustion chambers during the year.

Separate collections are made for ashes. Other large non-combustible items are supposed to be excluded, but a certain amount does pass through the plant cycle. Chunks of masonry have been found which, of course, cause damage to the refractories and furnace parts.

During 1957, which included the starting and instruction period, a total of 28,474 tons were handled for a total plant superintendence and operating wage cost of $67,766, or $2.37 per ton. Allowing for the increased wage rates in effect in 1957 as compared with the 1954 estimates, the actual burning labor cost compares favorably with the goals. Other recurring operating expenses included those for supplies, electricity, fuel, and telephone, totaling $6,300. Repairs, including some minor improvements, totaled $2,700.

Two typical recent weeks, in March and April 1958, showed a total plant labor cost of $2,452, a total of refuse burned of 1,175 tons, and an actual furnace operation of 105 hours. The indicated labor cost of $2.08 per ton reflects the improvement in techniques achieved after the first full year of operation.

Fly ash trapped

Accurate weight records have been kept of the fly ash trapped in the settling chamber and these show an average weekly accumulation of 0.1 percent of the weight of the raw refuse.

Density measurements taken of the fly ash, after removal, showed 15.2 lb per cu ft. Some 65 percent by weight was located in the first compartment nearest the combustion chamber, and the remainder spread over the other four compartments with No. 5, adjacent to the chimney, holding less than 4 percent. This is exclusive of the slag particles which are mostly found in the combustion chambers. It was originally intended to empty the settling chambers each day so that trapping would not be lessened due to the formation of fillets of fly ash against each of the four impingement walls. However, the relatively clear character of the stack effluent, generally less than Ringleman No. $\frac{1}{2}$, and the almost total absence of complaints about fly ash, have made weekly removal sufficient.

In the summer of 1957 a public swimming pool was opened at the north end of Stow Flats, 2,100 ft from the plant, with no intervening structures. No deposition has been observed on the undisturbed pool surface and the pool manager has stated that, in so far as pool activities are concerned, there is no awareness of the adjacent plant.

In early 1958 a consulting engineer engaged to report to the County on site selections for a new County-wide auditorium, concluded that a site at Stow Flats next to the plant was the most suitable of the 14 sites studied in the Triple Cities area.

Now that a full year of operation has passed, the operation of the plant, coupled with the effectiveness of the settling chamber, demonstrates the achievement of Binghamton's dual goal of a modern refuse disposal system and the restoration of the Stow Flats area.

During the period of incinerator development, design and construction, Donald W. Kramer was mayor of Binghamton and played the principal part in its accomplishment, aided by the then executive assistant, the present mayor, John J. Burns. Technical direction throughout was by Regis C. McNamara, City Engineer, assisted by C. W. Coleman and Louis Darrow during construction. General management of refuse collection and disposal is by W. J. Spellicy, Commissioner of Public Works, with incinerator operations under Paul Perchinsky, Plant Superintendent.

Design of the entire facility and advice during construction and operation were provided by the consulting engineers, Leonard S. Wegman Co. of New York, the writer and Herbert Mandelbaum, M. ASCE, partner, were in overall charge of this project, assisted by Viggo Westergaard and Charles Kandall, consultants.

◄Prestressed beams up to 93 ft long are used on 219 structures on the Northern Illinois Toll Highway.

Prestressed concrete is used wherever practicable on the Northern Illinois Toll Highway. As the tollway was started at a time when steel for structures was on a long delivery schedule, a great deal of thought went into adaptation of materials that would be available economically, when needed. An innovation in this field is the use of large-diameter, prestressed-concrete open pile-columns to make up the complete substructure of a bridge. Precast prestressed concrete girders are used with a composite deck for most structures of short and moderate span.

The Northern Illinois Toll Highway actually consists of three connected facilities that will directly serve 60 percent of the people of the state. The Tri-State Tollway parallels the shore of Lake Michigan to connect Indiana with Wisconsin, by-passing Chicago. The Northwest Tollway originates near the northwest edge of Chicago and carries traffic through Elgin and Rockford to South Beloit. The East-West Tollway

▼ Swamp area and railroad are spanned by prestressed beams supported on pile-columns, which are driven to form entire substructure except for cast-in-place pier caps.

PRESTRESSED CONCRETE DOMINANT

on Illinois Toll Highway structures

extends from Chicago to northwest of Aurora, where it connects with Route U.S. 30.

Prestressed concrete girders with a composite deck are used on 219 of the 265 bridges on the toll highway and steel girders are used on 49 structures. (Three are a combination of structural steel and prestressed concrete.) A bridge over the Fox River and over transportation routes north of Aurora has five thin-shell arch spans flanked by prestressed concrete girder approaches. A cantilever steel girder spans 260 ft over the Illinois Waterway.

Despite varying span lengths and conditions, planning was so well done for mass production of beams from 40 to 93 ft long that only three cross sections were needed. And two of these had the same contour so could be built with one set of forms. Use of these prestressed beams is estimated to have effected a saving of $10 million.

Paving is all concrete with lanes in each direction 25 and 37 ft wide for two and three lines of traffic. Thickness is a constant 10 in. with wire mesh reinforcing. The ruling grade is 2 percent.

Toll stations are generally of the barrier type across the main road and are not more than 12 to 15 miles apart in most areas. To meet financing costs, tolls will be about 2 cents per mile. Service areas are directly opposite for traffic in each direction, and have common over-the-road dining facilities.

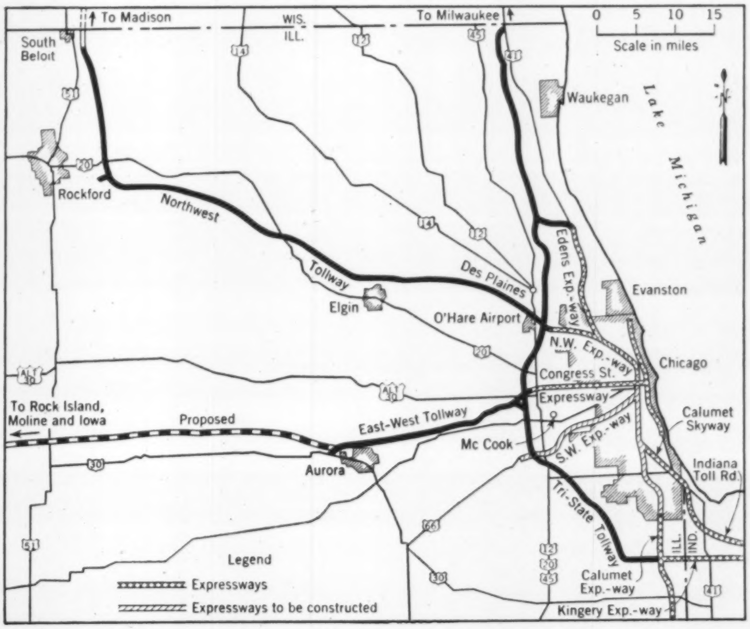
The engineering contracting arrangements for the Toll Highway are especially adapted to provide the speedy construction essential to successful toll financing. Principal consulting engineers for the Illinois State Toll Highway Commission are Joseph K. Knoerle & Associates Inc., of Chicago and Baltimore. Working with them are 23 engineering firms, each handling design to established standards and supervision of construction for a portion of the 187-mile toll facility.

Contracts for construction have been awarded on a competitive-bid basis for almost all the work. Projects range in length up to 12 miles and in contract amount from a million to 23 million dollars. Supply contracts totaling $37 million were separately awarded for structural steel, fencing, guard rail, cylinder piles and precast concrete members. Forty-three roadway and structure contracts totaling more than $228 million were awarded to 23 contractors in a 13-month period at an average rate of $17,500,000 per month. Construction contracts total nearly $300 million; right-of-way expense is $56 million; relocating utilities will cost $5 million; and engineering will add $25 million. Financing and other costs bring the total up to $441 million.

Construction, as of June 1, is more than 60 percent complete on the entire project. The 75-mile Northwest Tollway and the Tri-State Tollway in Lake County are scheduled for use at the end of July with the rest of the facility to be completed late this year.

Some 85 percent of the 75,000,000 cu yd involved in the work has been moved. It is expected that on June 1 paving will be completed for 75 miles of four-lane and 10 miles of six-lane highway. A very large mileage of additional lanes is not included in the above figures.

Bridge substructures are almost all completed and superstructure work is progressing rapidly. The problems of fabricating, delivering over a 187-mile road length, and installing cylinder piles for 89 structures under 18 engineering organizations and 19 contractors are detailed in the following article by Myers Van Buren. The procedures in fabricating and delivering a portion of the 417,000 lin ft (80 miles) of precast concrete girders used on the tollway are related in the article by Charles C. Zollman.


To Madison
WIS.
ILL.
To Milwaukee
0 5 10 15
Scale in miles
South Beloit
14
12
45
41
51
Waukegan
Lake Michigan
20
Rockford
Northwest
Tollway
Des Plaines
Edens Exp.-way
Evanston
Elgin
O'Hare Airport
N.W. Exp.-way
Chicago
Congress St.
Expressway
ALT 30
To Rock Island, Moline and Iowa
Proposed
East-West Tollway
Calumet Skyway
Mc Cook
S.W. Exp.-way
30
Aurora
Indiana Toll Rd.
Tri-State Tollway
66
ILL.
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Expressways
Expressways to be constructed
Calumet Exp.-way
Kingery Exp.-way

Northern Illinois Toll Highway in its 187-mile length consists of three parts—Northwest Tollway, Tri-State Tollway, and East-West Tollway.

ILLINOIS TOLL HIGHWAY

Piles double as columns on tollway structures

MYERS VAN BUREN, M.ASCE, **Prestressed Products Engineer, Raymond International Inc.**

Precast, prestressed hollow concrete cylinders make up the entire intermediate substructures for 94 bridges on the Illinois Toll Highway. Such elements have not generally been used for grade separation structures, but availability and the indicated saving made their use most desirable in this case. The column and its foundation are here combined in a single precast unit, eliminating the multiple-pile foundation, pile cap, and poured-in-place column normally required.

Highway engineers are designing more and more of their bridge columns as circular members, particularly where automotive traffic passes under the structure. The round column gives a more pleasing appearance. Studies by the consulting engineers on the Illinois Toll Highway indicated that the use of a driven, prestressed, hollow cylinder would shorten the construction time and reduce the overall cost as compared with the more conventional bearing-pile cluster, pile cap, and cast-in-place column.

Before recommending this type of construction to the Illinois State Toll Highway Commission, Joseph K. Knoerle & Associates, Inc., the principal consulting engineers on the tollway, made a careful comparative design and cost analysis. The structure used for comparison was a four-span underpass on a skew of 28 deg. It was 239 ft long, 24 ft wide from curb to curb, with safety curbs 2 ft wide. Cost estimates indicated a saving of 36 percent for the pier design in which a one-piece precast pile-column was used. This 36 percent is not necessarily the average saving for the 94 bridges, because of variations in subsoils.

Not included in the cost figures were savings expected to accrue from shortened construction schedules made possible by the use of this technique. The time needed for installation of the pile column was no more, and in many cases was less, than that required for a multiple-pile cluster to support the same load. The time usually required to form and pour the pile cap and column was saved.

To make sure that designs and estimates were correct, as any errors would be multiplied many times in the 94 similar structures to be built, one structure on the toll highway system was quickly built and thoroughly tested. The results obtained fully confirmed the validity of the consulting engineers' designs and estimates. Two informative articles on this test structure were presented at the World Conference on Prestressed Concrete in San Francisco last year, one by M. E. Bender and one by Jack Janney and W. J. Eney, M.ASCE. Both articles can be found in the conference *Proceedings*.

The design developed from the studies and tests called for a hollow pile-column 36 in. in outside diameter, with a $4\frac{1}{2}$-in. wall thickness, prestressed to a design compressive strength of approximately 750 psi. The pile-column could be either pretensioned or post-tensioned. Its cap could be precast or cast-in-place. The superstructure utilized pretensioned, prestressed beams. A cast-in-place concrete floor ties the beams together and, through the cap, to the pile-column and girders of adjacent spans so that under live load the structure acts as a continuous frame over three and four spans. The pile-column is assumed to be hinged 5 ft below the ground line.

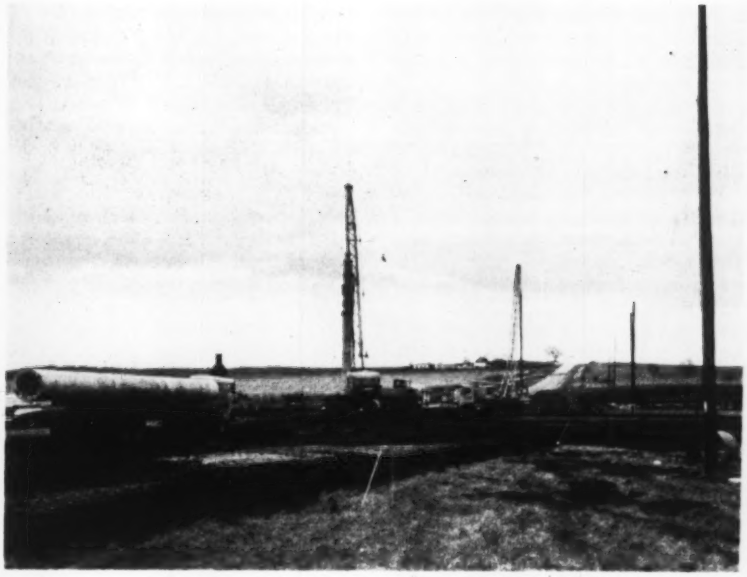
The 187-mile highway was divided into some 40 general contracts of which a few are for major bridges. Road contracts included all phases of construction for a completely finished highway, except for furnishing and installing the pile-columns and furnishing and delivering the steel for major bridges and the prestressed concrete beams for other structures.

The consulting engineers realized that to obtain low bid figures for this substructure and girder work the number of units in any single contract should be large. Therefore normal contract methods were revised. A majority of the 50,000 lin ft of pile-columns was let in a single general contract. The 417,000 lin ft of beams were let in four general contracts.

The Raymond Concrete Pile Company, now a division of Raymond International Inc., had contracts for supplying pile-columns for all 94 bridges and for the installation at 90 of them. Raymond elected to use its standard sectional post-tensioned cylinder pile, which required little change to meet the tollway specifications. This pile has been in use for a number of years, most notably for the 24-mile Lake Pontchartrain Causeway. (See Mr. Van Buren's article in CIVIL ENGINEERING for February 1957, p. 33.) The Raymond cylinder pile is cast in sections. The standard fabrication length was 16 ft with special sections of 4, 8 and 12 ft. When the sections were assembled, a pile-column of any multiple of 4 ft could be made.

The hollow, cylindrical sections were formed by horizontal centrifugal casting. This is a technique used for many years by the concrete pipe industry. The concrete is placed in a revolving mold that forms the exterior and end surfaces. No interior form is required. The centrifugal force consolidates the plastic concrete. Frequently vibration and internal rolling are used to assist the consolidation process. For this job only rolling was used. Steam curing permits form stripping after 4 hours.

Prestressing was accomplished by 12 No. 6 wires in each of eight holes of $1\frac{3}{8}$-in. diameter cast through the center of the $4\frac{1}{2}$-in. wall. The required sections, to make a specific pile length, were placed end to end with the $1\frac{3}{8}$-in. holes in alignment. The 12-wire group was pushed through each of the eight aligned holes. The eight cables of 12 No. 6 wires, initially post-tensioned to 150,000 psi, to produce a design stress of 120,000 psi, developed the required concrete compressive design stress of 750 psi. After stressing, the cable ducts were pressure filled with neat cement grout. When the grout had set suffi-



At typical construction site on Illinois Tollway, holes are being predrilled by coring rig at right. In center is pile-driving rig on a truck crane. At left a prestressed pile-column is being delivered by truck.

ciently, the temporary anchors holding the cables were removed.

The pile-columns were produced at a plant of the Lock Joint Pipe Co. at South Beloit, Ill., near the northern terminus of the Northern Illinois section of the toll highway. Distribution of pile-columns to the 94 sites, scattered over the entire toll highway, was by truck. Loading at the plant was simplified by rolling from elevated storage racks at truck height and by the use of lift trucks. At the bridge site, either the installation crane or a lift truck was the unloading medium. For a structure carrying a secondary road over the toll highway, a minimum of nine pile-columns were required. The largest structure required 119 units.

Because of the large number of major moves required, truck cranes were employed almost entirely as the installation tool. Cranes with a rated capacity of 35 and 45 tons proved satisfactory. A pile of maximum length, 88 ft, weighed about 21 tons.

Seven general methods were employed for installation (Fig. 1). Where the pile-column was driven, specifications required a hammer with a capacity of not less than 40,000 ft-lb. To meet this requirement, a Raymond 3/0 hammer was employed. This is a single-acting hammer with a 12,500-lb ram and a drop of 3¼ ft, producing 40,625 ft-lb of energy.

No leads were used on the pile-driving crane. A starting hole was used so that the pile-column could be held in a vertical position without assistance from the crane. Of the seven installation methods shown in Fig. 1, Methods I and II are considered "normal" pile driving techniques. Here the pile is driven to the required resistance with or without the assistance of water jets.

In areas where stiff clays extended to some depth, an undersize hole (Method III) was made to a depth less than the final penetration. The diameter of the undersize hole for the installation of the 36-in. pile-column varied. A 34-in. hole was commonly used. The pile was driven with the hammer to the penetration and resistance required to support its design load.

Method IV, a variation of Method III, was used where layers of granular material, which would not maintain an open hole, were encountered before the required depth of the undercut hole was reached. In such cases it was necessary to drill an overcut (oversize) hole and install a steel casing through the area of unstable material. The casing

At pile-column assembly plant in South Beloit, Ill., sections produced at rear are assembled at right for post-tensioning and grouting, then rolled to car on transfer track.

Here Illinois Toll Highway crosses a secondary road on two three-span structures. Wheel guards, which encircle pile-columns at ground level, are separate from the columns.

was pulled after the pile-column was set but before driving began. The void outside the pile-column was filled with sand before driving. Vibration induced by the hammer during driving produced good compaction of the sand.

Where rock formations were close enough to the surface, an overcut hole was drilled to the rock (Method V), the rock surface was cleaned, enough concrete for a height of 2 ft was placed over the rock, and then the pile-column was set in the plastic concrete. The void between the pile and the overcut hole was carefully filled with sand.

In areas where it was determined by soil analysis that sufficient load bearing capacity could not be obtained by friction or point bearing, or both, without going to considerable depth, Method VI was employed. Here an overcut hole was drilled to a hard stratum, a bell of proper size was formed and then filled with concrete. Next the pile-column was set in the plastic concrete. Finally the area between the pile and the overcut hole was carefully filled with sand. In actual practice, both here and in Method V, the pile was set before the concrete was placed. The pile was supported above the bottom of the hole. Where a belled hole was used, the point of the pile was held at about the top of the belled portion.

In numerous instances Method VI could not be used because of the presence of heavily water-bearing granular materials. These made it extremely difficult to seal off the casing. In these instances the pile-column was driven through the troublesome area to the desired hard stratum (Method VII) and then the bell was formed below the pile point.

By using one or more of these seven installation methods, it was possible to satisfactorily install pile-columns at all 94 sites over the 187-mile length of the highway under varied soil conditions. In no case was any other type of foundation required.

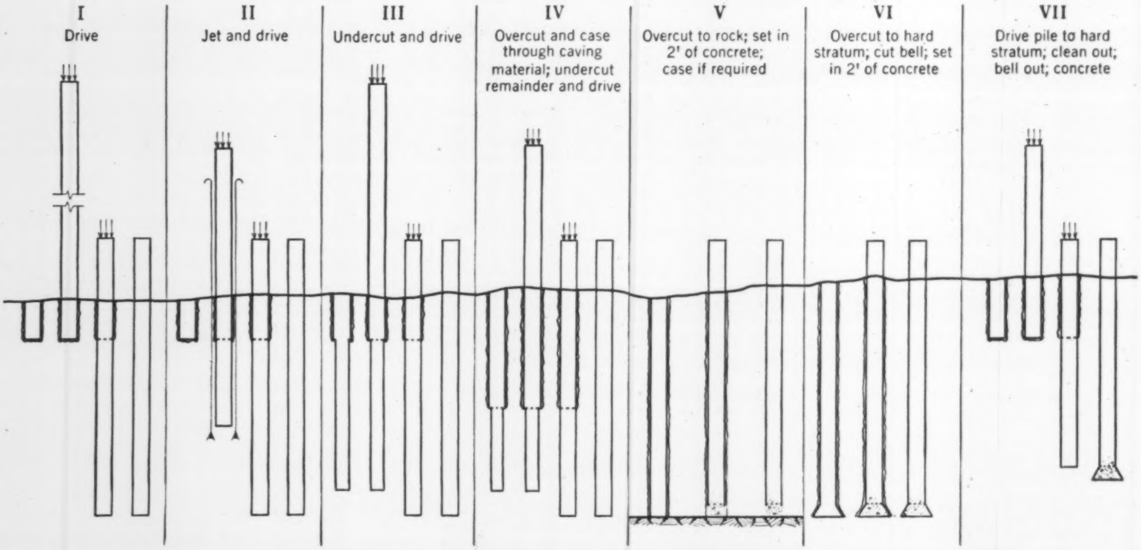
As the job progressed, improved installation techniques checked by test-load results permitted a considerable reduction in the depth to which piles had to be installed, as compared with the engineers' estimates. The saving in cost was about 20 percent of the bid figure. This, coupled with the consulting engineers' estimates of the saving resulting from the use of the pile-column design, brings the total cost considerably below that for a conventional design utilizing multiple piles, pile caps, and poured columns. As previously mentioned, no valuation was placed on the shortened construction period made possible by the pile-column technique. During one 30-day period a total of 18 substructures were completed, using four spreads of equipment, working a total of seven shifts a day, five days a week.

An unusual feature of the job was the relationship between the consulting engineers, the section engineers, and the contractors. For Raymond's main contracts, which included 90 bridges, the manufacturer of the pile-columns was under the supervision of the consulting engineers as a material item. The installation was under the direct supervision of 17 groups of section engineers, each in his own section. In addition, though a prime contractor, Raymond had to dovetail the installation with 19 general contractors who had various sections of the highway in which pile-columns were used. With 17 section engineers and 19 contractors' superintendents to be satisfied, it required fast moving, patience and tact on the part of Raymond's personnel to keep the majority happy.

A definite installation schedule was set up in the contract specifications. This quickly became inoperative because of the non-availability of right-of-way, an extremely rainy season, and a general inability to predetermine the schedules of the various construction superintendents. However, most operations were completed with a minimum of delay through the cooperation of all parties. With the exception of the test structure, the installation of the pile-columns for the 94 structures began in March 1957 and was completed by March 1958.

For the Illinois State Toll Highway Authority, George L. Jackson, M. ASCE, is Chief Engineer. Representing Joseph K. Knoerle and Associates, Inc., overall consultants for the project, R. F. Graef, M. ASCE, Chief Engineer, and M. E. Bender, Chief Bridge Engineer, were responsible for the bridges, for which plans were prepared by the several section engineers. Robert G. Majhor, A.M. ASCE, was general superintendent for Raymond on fabrication and installation of the pile columns.

FIG. 1. By utilizing seven methods of installation, here illustrated, 36-in pile-columns were adapted to all 94 sites where their use was originally planned for all parts of the 187-mile Northern Illinois Toll Highway.


I
Drive
II
Jet and drive
III
Undercut and drive
IV
Overcut and case through caving material; undercut remainder and drive
V
Overcut to rock; set in 2' of concrete; case if required
VI
Overcut to hard stratum; cut bell; set in 2' of concrete
VII
Drive pile to hard stratum; clean out; bell out; concrete

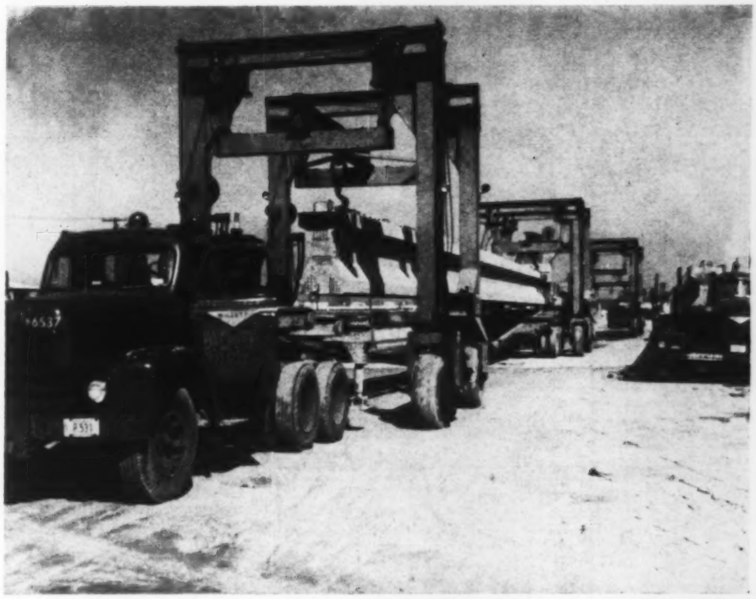
Bold planning results in efficient production of prestressed girders

CHARLES C. ZOLLMAN, M. ASCE, Partner, Charles C. Zollman and Associates, Consulting Engineers, Newtown Square, Pa.

For the bridge structures with precast, prestressed girders required on the Illinois Toll Road, conceived, designed, and prepared for the entire program by the Consulting Engineers, Joseph K. Knoerle & Associates, Inc., of Baltimore, Md., and Chicago, Ill., considerable thought had to be given by precasters so that a most efficient method for manufacturing these girders could be attained. For one of the plants, located at McCook, Ill., designed to cast 1,300-odd girders, about one-quarter of the girders required for the entire toll road, carefully selected equipment and a well planned casting yard make it presently possible to complete a string of girders each second day on each of four casting and stressing lines. Number and length of lines, provisions for placing, draping and stressing the strands, and for curing and moving the finished girders were carefully scheduled for a 48-hour cycle in this plant of the Prestressed Division, Consumers Company of Chicago, so that two casting lines could be worked simultaneously and produce daily an average of 625 ft of girders.

To achieve this speed and economy in casting these 417,000 ft of girders, the precaster took advantage of the foresight of the Toll Road's Consulting Engineer, who developed a simple basic pattern for all the girders.

Despite the fact that girder lengths vary from 40 to 93 ft, and in weight from 12 to 46 tons, only three typical cross-sections are required. Even these three necessitate only two sets of forms, since Types 2 and 3 differ only in width. As shown in Fig. 1, Type 3 is 4 in. wider than Type 2 throughout.



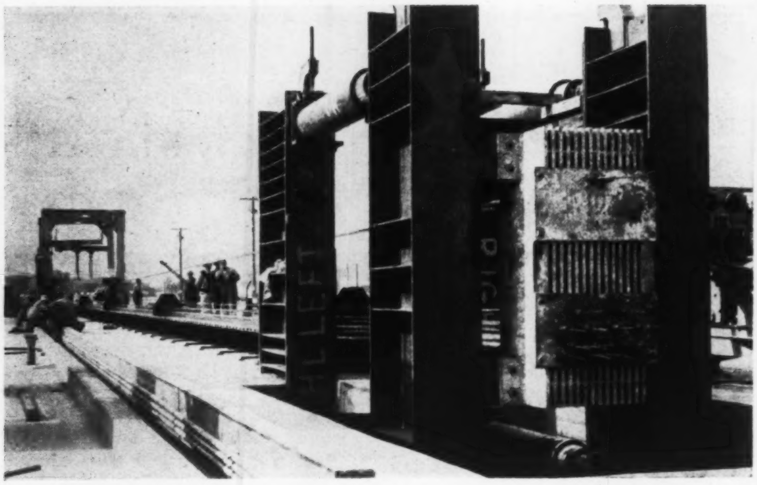
Travelift carriers move over pole trailer of truck to load prestressed beams up to 93 ft long. Travelift is powered by a gasoline engine.

Draping of strands

To satisfy the flexural stress requirements for the entire span range of from 40 to 93 ft, it is necessary to vary the number of strands as well as their trajectories in each of the three cross-sections. Thus, for the first time in American pretensioned assembly-line practice, a portion of the flexural stress requirements along the beam is to be satisfied by "draping" pretensioned $\frac{7}{16}$-in. strands. The strands within the web area of the girders are draped along paths shown in Fig. 2. Depending on the span length, two or four deviation points are provided, the Type 1 girder generally requiring only two deviation points.

In girders as long as 93 ft, up to 79 strands of $\frac{7}{16}$-in. diameter are necessary, and as many as 35 of these strands are draped. A total thrust of about 1,600,000 lb is thereby produced as strands are stressed up to 19,050 lb each. Because of draping, vertical uplift forces at the deviation points of the draped strands can be as high as 35,000 lb, and downward vertical forces at the posts between the girders can be as much as 120,000 lb. These are unusually severe horizontal and vertical forces; provision to resist such forces had to be made in the casting beds in a manner that would not hinder efficient production.

Consulting Engineer Knoerle thus challenged the ingenuity of the American producer to develop an installation for efficient production, as well as ways and means of handling economically such high horizontal as well as vertical forces, which could occur anywhere



"Live" end of casting bed has equipment for pretensioning. Note trench for utilities between casting lines.

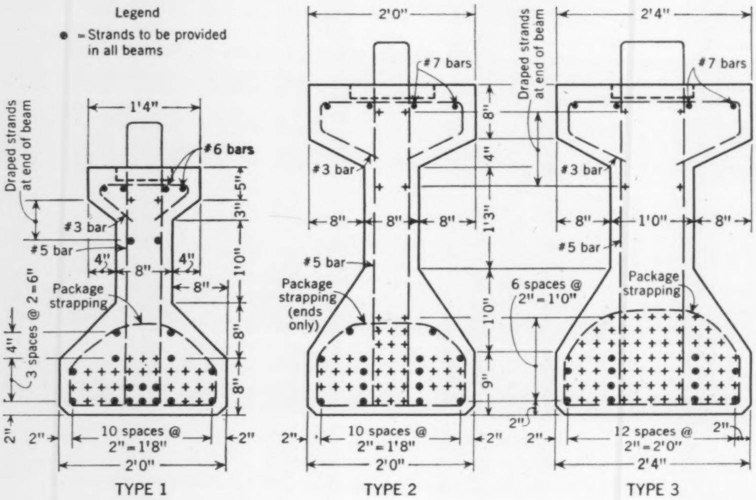
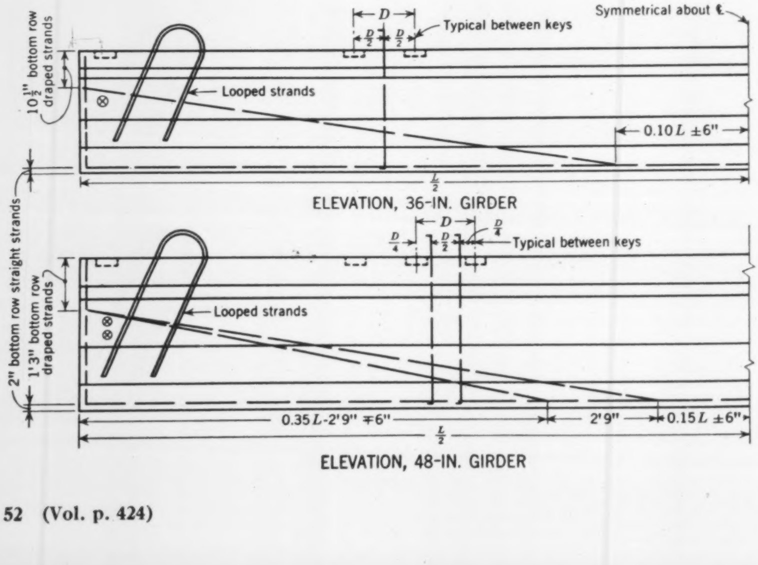

Legend
● = Strands to be provided in all beams
Draped strands at end of beam
1'4"
#6 bars
#3 bar
#5 bar
4"
8"
Package strapping
3 spaces @ 2 = 6"
4"
5"
3"
1'0"
8"
2"
10 spaces @ 2" = 1'8"
2'0"
TYPE 1
2'0"
#7 bars
#3 bar
#5 bar
Package strapping (ends only)
8"
4"
1'3"
1'0"
9"
6 spaces @ 2" = 1'0"
10 spaces @ 2" = 1'8"
2'0"
TYPE 2
2'4"
#7 bars
#3 bar
#5 bar
Package strapping
1'0"
12 spaces @ 2" = 2'0"
2'4"
TYPE 3

FIG. 1. Typical beam sections are shown near center for Types 1, 2 and 3. Note that Type 3 is identical with Type 2, except that it is 4 in. wider throughout. Side forms can be the same; only bottom pallets differ. Types 1 and 2 can be cast on the same line.

FIG. 2. The 7/16-in. strands are tied down and pretensioned in the beams, which vary in length from 40 to 90 ft.

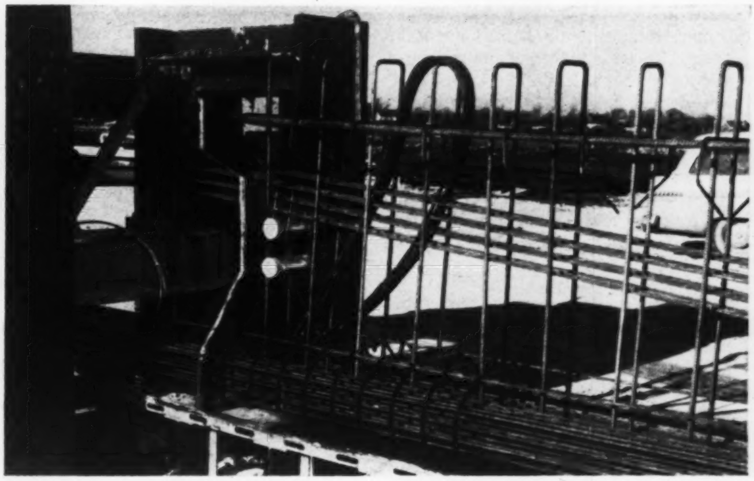

$10\frac{1}{2}$" bottom row draped strands
D
$\frac{D}{2}$
$\frac{D}{2}$
Typical between keys
Symmetrical about ℄
Looped strands
0.10L ±6"
$\frac{L}{2}$
ELEVATION, 36-IN. GIRDER
2" bottom row straight strands
1'3" bottom row draped strands
D
$\frac{D}{4}$
$\frac{D}{2}$
$\frac{D}{4}$
Typical between keys
Looped strands
0.35L-2'9" ∓6"
2'9"
0.15L ±6"
$\frac{L}{2}$
ELEVATION, 48-IN. GIRDER

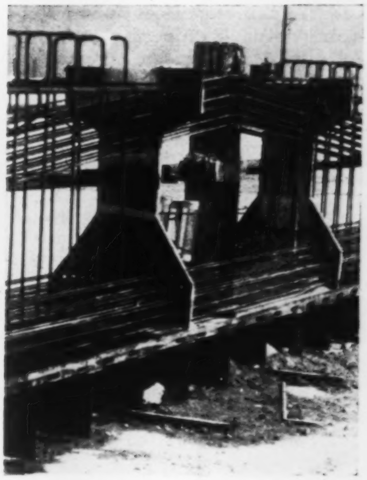
along the casting bed because of the variations in beam length.

The Consulting Engineer for the Toll Road Commission did minimize the producer's problems, however, by instigating early tests which verified the fact that end blocks (which would widen the web of the girder at the end) and diaphragms were not essential. This would permit continuous forming for the entire length of a casting bed. With the assistance of an experienced prestressing consultant and a production consultant to aid the producer's staff in the planning, construction and initial operation of this plant, the challenge was met by the producer as familiarity with the new problems of high forces and draping of strands, along with assembly-line procedures for production, were recognized as essential.

Also, it was recognized that before a casting yard is laid out, major equipment must be selected and a general plan of operation worked out. In such planning considerable help can be obtained from specialists in precasting and prestressing, since general contractors normally do not have this specialized work often enough to become familiar with all details. It was realized at the outset that the selected basic handling equipment would be the crucial element in the success or failure of the undertaking, as it became evident that the entire installation and operation had to be evolved around this piece of equipment.

All types of conventional equipment, such as crawler cranes, overhead cranes, gantries, forklifts and lumber carriers were considered and all were eliminated. A Travelift of 25-ton lifting capacity appeared most versatile and economical. It is a hydraulically operated unit similar to a lumber carrier





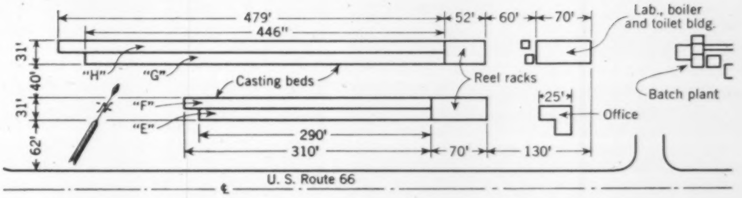
Strands within web area were draped before tensioning. Looped strands are salvaged cable ends, which will be used to lift the girder. Reinforcing is preassembled and set in the form. Note clamped strapping around lower strands, taking the place of stirrups.

but with greater underclearance, more versatility and high capacity. It was adapted to prestressed work in this yard for the handling of forms, finished girders, and a number of other incidental but necessary operations, from a rig previously developed to transport pleasure boats. Available at less than $15,000, it needed to be supplemented only by a hydraulic truck crane for handling reinforcing and a wheeled tractor with front-end loader to place concrete, supplied via transit-mix trucks from the batching plant erected nearby.

For the yard of Consumers Company, the basic concept of operation was to have the Travelift straddle each casting line with sufficient clearance to carry forms or girders over the uprights at the dead end of the bed. See Fig. 3. Selection of the Travelift, with its clear width of 12 ft and load distribution to four wheels, determined the shape of the casting beds. See Fig. 4.

It was determined that four casting lines would be required to cast the 1,330 girders. These lines are of varying lengths so that about the same number of casting days are needed for each line, with girder Types 1 and 2 (24 in. in bottom width) to be cast on one pair of lines. Girder Type 3 (28 in. in bottom width) is cast on the shorter pair of lines.

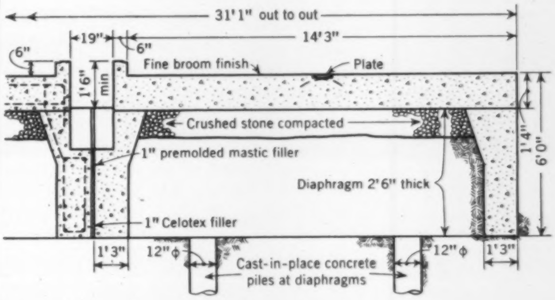
Again, for efficient production, it is imperative that each casting line be ac-



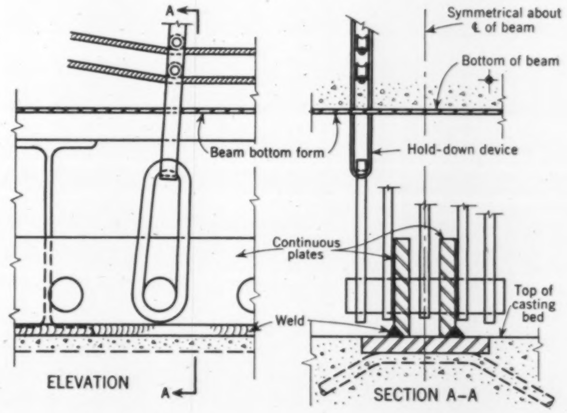
479'
446"
52'
60'
70'
Lab., boiler and toilet bldg.
31'
40'
31'
62'
"H"
"G"
Casting beds
Reel racks
Batch plant
"F"
"E"
25'
Office
290'
310'
70'
130'
U. S. Route 66
℄

FIG. 3. Casting and pretensioning yard of Consumers Company is seen in plan.

FIG. 4. Casting slab is made unyielding and to very close tolerances.



31'1" out to out
19"
14'3"
6"
6"
1'6" min
Fine broom finish
Plate
Crushed stone compacted
1" premolded mastic filler
Diaphragm 2'6" thick
1'4"
6'0"
1" Celotex filler
1'3"
12"ϕ
Cast-in-place concrete piles at diaphragms
12"ϕ
1'3"



A
Symmetrical about ℄ of beam
Bottom of beam
Beam bottom form
Hold-down device
Continuous plates
Top of casting bed
Weld
ELEVATION
A
SECTION A–A

FIG. 5. Hold-down for pretensioning of draped strands keeps friction drag to a minimum.

cessible; this requirement was met by arranging the lines in pairs with a 40-ft roadway between the two pairs. It was also important to provide sufficiently wide roadways so that rolling equipment could operate properly. Casting yards should never be cramped!

Between the two casting lines in each pair of lines a sloping trench is provided to house utilities such as steam, water, air, electricity, and communication lines so that no permanent element projects above the surface of the beds—an important consideration for efficient production.

To string the prestressing strands efficiently, a supply reel is provided for each strand required. Reels are placed at the live end of each pair of casting lines. The layout of the reel racks is such that the Travelift can straddle a pair of reels to replace them when needed, or carry over them.

To string the strands, the multipurpose Travelift carries the dead-end template from the dead end of the bed to the live end. Strands are threaded through the live-end template, sometimes through several collected intermediate templates for the straight strands, and through the dead-end template. The strands are thus kept in the right position on all templates. The Travelift carries the dead-end template, pulling the strands attached to it to the dead-end, thus placing at one time all the strands required in a line of girders. For strands that are to be draped, and sometimes for the straight strands, templates are slotted and inserted over the stretched strands.

A rapid method of tensioning had to be evolved for both straight and draped strands so that all the operations preparatory to placing of concrete could be performed within an 8-hour cycle. The strands that had to be draped were given the trajectories they were to have in the finished girders—before stressing.

An ingenious roller arrangement (Fig. 5) is used to hold strands down to the required trajectory. At the ends of girders the strands rise over pins on a post. The post and bulkheads can be moved longitudinally to provide for the manufacture of units of different lengths. During the early production days, most of the stress in the strand was achieved at the "live" end of the bed by four power-operated hydraulic jacks (of 300-ton capacity each) that have a travel of 48 in. Provision was made for some nominal stressing at the dead end of the bed to equalize stress in the long strands as they follow the up-and-down trajectory required for the several girders in the long casting bed.

Subsequently the stressing procedure was modified to a single stranding operation in lieu of the previous simultaneous stressing of all the strands, as it appeared to be a more economical operation with these girder designs. It is believed that because of proper early planning the changeover was effected without interruption in production.

After stressing is completed, a Hyster hydraulic-crane truck places the preassembled reinforcing cages. Initiated by the project engineer of the Consumers Company, simple banding of the bottom strands replaces, for the first time in prestressed concrete work, the tedious insertion of stirrups. With this arrangement the reinforcing is set without delay, as the bands of heavy strapping can be quickly clamped at the required spacing. The steel side forms are set by the Travelift and attached to the casting bed by quick-tightening bolt assemblies.

The girders are then ready for concrete, which is placed by the front-end loader. About two hours after concreting is completed, steam curing is commenced. A 4,200-psi strength is achieved in about 14 hours. By that time another casting bed is ready to receive the side forms, which are stripped and moved to the next bed by the Travelift.

The prestressing forces are released by burning the wires at the ends of the casting bed and at the bulkheads between beams, following a definite sequence.

Storage, transportation, erection

Travelifts operating in tandem remove the girders from the bed to nearby storage. Even though the girders are grouped by bridges for delivery, they may be produced by casting those for several bridges on the same bed in order to save time and material. Consequently, careful programming of storage is needed to minimize handling during the truck loading operation.

For transportation to the erection site, the girders are loaded on special trucks which have been assembled for delivery of the heavier girders so as to comply with state and county load restrictions. The loading is done by the Travelifts, which have sufficient underclearance to travel over the truck cab. Triple-axle assemblies with provisions for separate steering facilities are features of the rear truck supports designed for hauling the longest girders.

To prevent chipping of the edges of the beams at the support points, adequate shock-absorbing cushioning material must be provided over the truck bolsters. Proper blocking at the truck supports, so that the vertical position can be maintained, is an important additional requirement.

At this plant, waste prestressing strand is made use of for the lifting hooks by bundling several strands together and placing them in the girder so that there is at least 4 ft of anchorage in the concrete. These strands are placed with great care to make certain that the bundles are tight so that all strands share the load equally. The flexibility of the strand minimizes bending stresses.

All the girders are erected by crawler cranes. For long members two cranes are used, while for the shorter beams a single crane is sufficient. In the latter case lifting yokes or extra-long cables are used to limit excessive erection stresses.

Production well integrated

When the producer had been provided with the proper tools—four Travelifts, one lift truck and one front-end loader—and had been given *adequate* physical facilities as well, there was no problem in dovetailing all the operations. Thus the crews can work alternately on the various casting beds; girders are produced right on schedule and stored so as to permit proper loading sequence.

The efficient casting-plant operations here described are the result of the joint efforts, primarily before plant construction began, of the prestressing consultant, the builder, and the production consultant—all working under the guidance of a capable project engineer. The girder designs were developed by consulting engineers who understood that efficient production is the key to prestressed girders of low cost and high quality.

Located at McCook, Ill., the plant was planned, designed and built from May to October 1957 for the manufacture, now almost completed, of the 1,330 beams required for one section of the toll road. The plant is owned by the Consumers Company, Chicago, Ill., now a Division of Vulcan Materials Company. A. H. Gustaferro, A.M. ASCE, Project Engineer during the early stages of development and now Superintendent of the Prestressed Concrete Operations of Consumers Company, is responsible for many of the yard developments.

Charles C. Zollman and Associates, Newtown Square, Pa., were the Consulting Engineers to the Consumers Company on the plant layout and design, and George A. Cooney was their special consultant on production. Western-Knapp Engineering Company of Chicago, Ill., built the entire plant.

The prestressed girders were designed for the Illinois Toll Road Commission by Joseph K. Knoerle and Associates, Inc., of Baltimore, Md., and Chicago, Ill.

The engineer-contractor relationship

HERBERT R. FALK, Assistant Civil Engineer, New York State Department of Public Works, Poughkeepsie, N. Y.

One of the most difficult problems the field engineer has to face is his personal relation with the contractor when he is the engineer-in-charge of a project. It is very hard to strike just the right note in personal relations. Some men are born with this "knack of leadership." They never have to argue. They never raise their voices. They say "do this" and it is done. They command the respect of their associates and run a job well. Conversely, some engineers do not have this knack and never learn it. They find it very hard to get contractors to obey instructions. They are either too easy going or too rigid. The result is constant bickering and lack of harmony. The job and the owner suffer.

Just what should be the attitude of the engineer toward the contractor? How can a balanced, harmonious relationship be attained? And maintained?

There are no hard-and-fast rules. Individuals vary, as do jobs and contractors. The contractor is in business to make money. The engineer's task is to see that the job gets done and done right. These different viewpoints are not necessarily incompatible.

It is well to realize, and to convince the contractor, that all job forces are on the same team. The owner wants the best job he is entitled to, at the earliest practicable time. The engineer and the inspectors are there to get this job for the owner. But the engineer is also an arbiter and must resist any pressure on the contractor to do more than the contract calls for or to do extra work without fair compensation. You will find that most contractors want to build and maintain a reputation for good work.

In the interest of better engineer-contractor relations and to help young engineers just starting in the profession develop leadership, the following six points are offered for consideration.

1. Be firm. Once you have made up your mind, stick to it. Let's assume that you have thoroughly thought out a certain situation and have made a decision. You tell the contractor that something must be done in a certain manner. He starts raising the roof. Don't let him scare you. Nine times out of ten he is screaming for effect—or just to see how serious you really are. If you let his noise bother you, or change your mind, you are in for a lot of the same treatment every time. Make sure you're right. If you think you are—stick to it. But if some time you really are wrong, be man enough to admit it and correct your error. You will not lose standing by being fair.

2. Don't let anybody rush you. Many times you may be asked for a quick decision. Don't be hurried. It's best to take the situation back to the office with you and think it over in all its ramifications. You can be sure that the other fellow has thought it over. Ask yourself if this change or decision you have to make affects only what you are doing now, or will affect something else later. Remember that you are setting a precedent. Nothing looks quite so bad as changing your mind once you realize the full implications of your snap decision. You can't tell the contractor one thing one day and another thing the next.

3. Be fair. Many young engineers and others have a tendency to apply specifications too rigidly. They "go by the book." Even when they are shown an equal or better solution to a problem, they insist on following the specifications to the letter. In situations like that, common sense is your best friend. Your judgment will tell you when your contractor is honestly trying to do a good job. Remember many contractors have been around a good many years and have had a lot of experience. It pays to listen. There will be lots of times when you will be glad you did.

4. Don't be overfriendly. Most contractors try to cultivate the engineer. They are very eager to please him and to become good friends. Starting with coffee breaks, you will go to lunch and have a drink, and before you know it you will wind up by being very, very chummy. You'll be on a first-name basis. Soon you'll start thinking that the contractor is a fairly good Joe. The truth of the matter is that he probably is a very pleasant fellow.

Now you are in something of a predicament. Because, when the situation comes up—and it surely must—it's awfully hard to tell one of your "friends" to do something you know very well he isn't going to like doing. You are going to be thrown together a lot during the course of your project. And no one wants you to be stiff and unfriendly. A pleasant, courteous attitude with a modicum of reserve will help maintain an easy businesslike relationship. Keep your friends for your personal life.

5. Think ahead. It is taken for granted that the engineer is thoroughly familiar with what is happening on his project every day. But how about what's going to happen tomorrow? Try to anticipate tomorrow's trouble today. Look ahead. If you spot any trouble, talk it over with the contractor. Your foresight will probably save both the owner and the contractor money.

6. Be a diplomat. A soft answer gets better results than loud talk. Ask or request rather than order. Grease the wheels a little. An engineer acts somewhat as a broker in that he tries to bring both parties, owner and contractor, together in harmony, the end result being a job well done.

For better or for worse you are stuck with your contractor for the duration. It's a delicate situation at best. But with common sense and a good engineer-contractor relationship, your owner will get a good job, your contractor will do all right, and you will increase your stature in your chosen profession.

Part I. Abating pollution of Potomac River

Nation's Capital enlarges its sewerage

C. FRANK JOHNSON, M.ASCE

Engineer-Director for District of Columbia's Board of Engineers, composed of Chairman Frank A. Marston, Samuel A. Greeley and Gustav J. Requardt, all Members ASCE

Senior Engineer, Metcalf & Eddy, Boston, Mass.

Brick-lined invert is being constructed for concrete sewer to be 5 ft by 4 ft 6 in. Photo by District of Columbia, Department of Sanitary Engineering.

After a comprehensive three-year study of the sewerage and pollution problems of the nation's capital, the District of Columbia's Board of Engineers has recommended a $151,000,000 improvement program. Most of the work consists of relief sewers and pumping stations, but $18,000,000 is for additions and improvements to the sewage treatment plant.

A major part of the problem concerns the pollution of the Potomac and Anacostia Rivers and Rock Creek (Fig. 1). The first two are wide streams at Washington and capable of great recreational and some commercial use. Rock Creek, though small, traverses beautiful Rock Creek Park and is a valuable recreational asset, with potentiality for much greater use. There has been considerable agitation for cleaning up the waterways in the nation's capital. Wading is now prohibited in Rock Creek and use of the other streams for recreation is restricted.

Another important part of the problem concerns the inadequate capacity of many of the existing combined and separate sewers which now serve the District.

Although the Potomac and Anacostia Rivers are tidal streams at Washington, with a mean tidal range of 2.9 ft, the tidal action extends only about three-fourths of the way through the city. Washington is 100 miles upstream from the mouth of the Potomac, which discharges into Chesapeake Bay.

Tidal action results in an oscillating, piston-like movement in the rivers, with a net downstream movement gained for each tidal cycle. At smaller river flows, which usually occur in the warmer months, the same water moves back and forth past a given point several times. The unusually large cross-sectional area of the tidal sections of the

One of seven combined-sewer overflow structures discharges into Rock Creek. Such overflows are responsible for much of the pollution trouble in the Potomac River.

Combined sewer of brick and stone in foreground, 7 ft 6 in. high, was constructed in 1872. Rubble stone section beyond, of unknown earlier date, is oldest sewer in Washington.

system

Such activities as President's Cup Regatta on Potomac River emphasize need to keep this beautiful stream clean. Photo by Abbie Rowe, courtesy National Park Service.

rivers results in particularly low velocities, except during floods.

The oscillating movement causes mixing and dispersion of the sewage, greatly increasing reaeration. However, it also results in pushing polluting matter upstream and in longer detention of the polluting matter in the city, thus increasing some of the objectionable conditions.

The city is almost completely sewered. The central and older section (15,160 acres out of a total land area of 39,000 acres) is served by a combined system and the remainder by a separate system (Fig. 2). The sewered part of the Washington Suburban Sanitary District (Fig. 1), which is tributary to the District of Columbia system, is served by a system which separates sewage from stormwater.

Interceptors take the dry-weather flow plus some diluting stormwater from the combined sewers, and all flow from the separate system, and convey these flows to the sewage treatment plant located near the southerly limit of the city. Excess flows in the combined sewers are discharged or overflowed to the streams at some 70 locations.

Many of the existing combined sewers are inadequate in capacity, and some of the separate sewers are inadequate. These inadequacies result in troublesome flooding of streets and basements. Many of the interceptors are totally inadequate, resulting in excessive overflow of sewage into the streams, sometimes even causing overflows in dry weather.

The existing sewage treatment plant is a primary sedimentation plant which has been in operation since 1938.

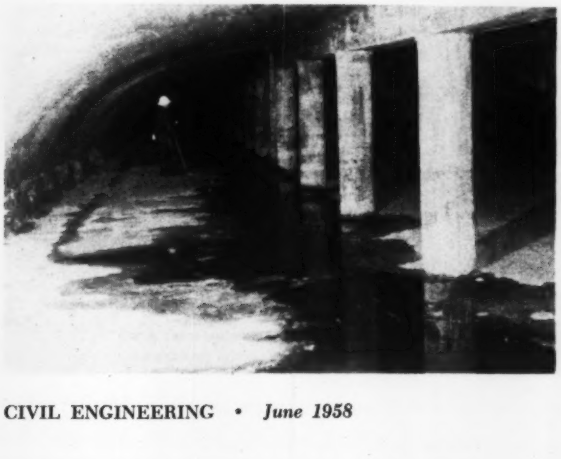
Pollution problems studied

Nine automatic gages were installed at important overflow structures, to record the occurrence and duration of sewer overflows to streams. In analyzing the records, successive overflows generally were counted as only one occurrence except when there was a 24-hour interval without overflow. However, dry-weather overflows occurring on successive dates were counted as separate occurrences.

Table I gives a summary of the results for 12 months at gages where overflows were excessive. Only from one to three overflows occurred at each of the other gages.

At three of the gages it was found that overflows occurred in dry weather, all during the warmer months, as summarized in Table II. Some of these overflows undoubtedly were caused by air-conditioning water discharged to the combined sewers, since the total

Combined sewer of 30-ft span, with stone sidewalls and brick arch, was built in 1873 with plank bottom. Concrete invert, columns and longitudinal beam were added in 1924.



In tunnel section of Piney Branch Trunk Sewer, 14 ft in diameter, reinforcing steel is being placed for invert. Photo by District of Columbia, Department of Sanitary Engineering.

flow was thereby increased so much that it exceeded the capacity of the interceptors.

It was evident from the record that the overflows were responsible for much of the pollution trouble. Two broad alternate solutions were studied: (1) elimination of overflows by converting all combined systems to separate systems, or (2) reduction of overflows to within tolerable limits by constructing large relief interceptors.

Separation of systems found too costly

To convert the large combined-sewer area to separate systems was estimated to cost $238,000,000, not including indirect losses to property owners, businessmen, and others. This would be a vast project, involving the entire downtown business district, as well as the surrounding densely populated fringes. New separate sewers would be built in every street, and in many cases two new sewers per street. The old combined sewers would be converted to storm sewers. The plumbing system in each building would have to be rearranged and a new house connection built, so the stormwater would be conveyed to the storm sewer and house sewage to the new separate sewer. Some relief sewers would be needed for the interceptors, and their cost is included in the estimated cost given above.

This cost would amount to about $15,700 per gross acre (15,160 acres) or $20,300 per net (sewage-producing) acre, as there are 11,740 acres involved, excluding parks, playgrounds, cemeteries, railroad yards, waterworks reservoirs, and airports.

A modified separation plan also was considered in which the new separate sewers would be designed to provide for sewage and roof water and the old sewers would take stormwater from streets, driveways, and lawns. This would require large separate sewers in every street, but no new house connections and no changes in plumbing.

The wholesale trenching of streets, alleys, and sidewalks, under either plan, would result in great expense and loss of business to commercial establishments and in severe inconvenience and hardship to property owners, shoppers, pedestrians, motorists, and others. It would take about 20 years to complete the work at a reasonable speed, thus delaying the pollution abatement that long. For these reasons and because of the great cost, this plan finally was rejected in favor of a plan based on reduction of overflows.

Under the alternate plan, it was necessary to determine an acceptable or tolerable scheme of overflows. This was approached on the basis of the "dilution factor," this factor being the ratio of interceptor capacity to the annual average dry-weather flow in the interceptor. The estimated dilution factor for existing interceptors proved to be very low, as expected, where excessive overflows were found. At four of the five locations given in Table I, including those in Table II, the dilution factor ranged from 1.3 to 2.2. At the other location, local conditions prevented satisfactory computation of a reliable factor.

The estimated dilution factor for three of the four locations which had only from one to three overflows during the year ranged from 69 to 95, and for the remaining location it was 3.6.

A study was made of the number and duration of overflows to be expected for various dilution factors, based on conditions estimated for the year 2000, from a hypothetical combined sewer serving the five combined-sewer districts farthest upstream and adjacent to the Potomac River, which have a total area of 1,012 acres. The results are summarized in Table III and the frequency data are shown in Fig. 3.

As part of this study, interceptors were designed to serve these five areas, using alternate dilution factors of 7, 10, 20, and 30, for each of which cost estimates were made and compared. It was concluded that for these particular areas a dilution factor of 30 was

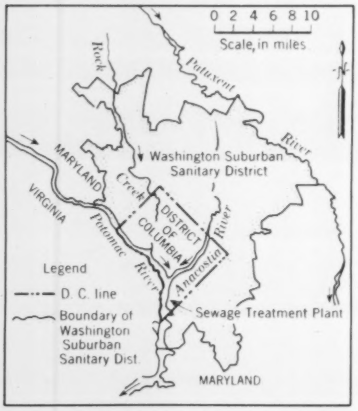

0 2 4 6 8 10
Scale, in miles
Rock
Patuxent
River
Washington Suburban Sanitary District
MARYLAND
VIRGINIA
Creek
DISTRICT OF COLUMBIA
River
Potomac
River
Anacostia
Legend
D. C. line
Boundary of Washington Suburban Sanitary Dist.
Sewage Treatment Plant
MARYLAND

FIG. 1. (Above) Three streams—Potomac River, Anacostia River, and Rock Creek—receive too frequent overflows from sewers.

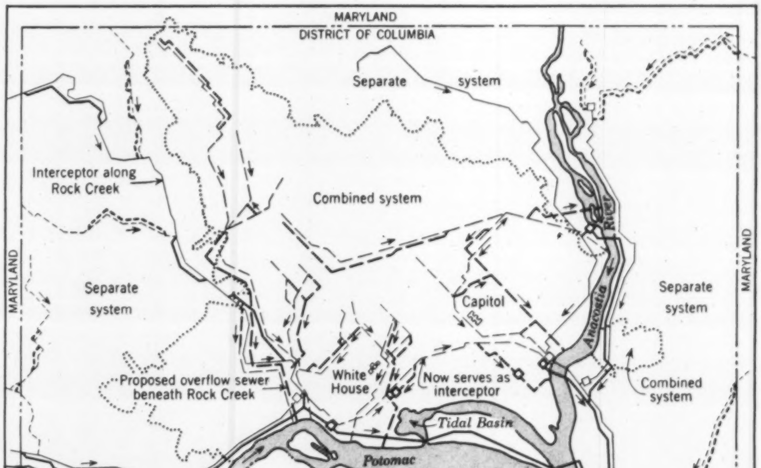

MARYLAND
DISTRICT OF COLUMBIA
Separate system
Interceptor along Rock Creek
Combined system
MARYLAND
Separate system
Capitol
Separate system
MARYLAND
Anacostia
River
Proposed overflow sewer beneath Rock Creek
White House
Now serves as interceptor
Combined system
Tidal Basin
Potomac
VIRGINIA
River
Legend
Principal existing works
Interceptors
Separate trunk sewers
Combined trunk sewers
Pumping stations
Proposed works
Interceptor reliefs
Separate relief sewers
Reliefs for combined sewers
Pumping stations
Sewage Treatment Plant
0 4000 8000
Scale, in feet
Limits of combined sewer system
Dist. of Columbia boundary line

FIG. 2. (Right) Central and older part of city is served by combined system, remainder by a system which separates sewage from surface drainage. Principal existing and proposed sewers are shown. All sewage flows to treatment plant in south corner of District.

TABLE I. Summary of overflows to streams where number was excessive

Location, Gage No.	Overflows in 6 summer months (May-Oct.): Number, Total	Number, Av. per mo.	Duration, hr., Total	Duration, hr., Av. per mo.	Overflows in 6 winter months (Nov.-Apr.): Number, Total	Number, Av. per mo.	Duration, hr., Total	Duration, hr., Av. per mo.
3	52	8.7	376	63	23	3.8	183	31
4	30	5.0	179	30	26	4.3	166	28
5	61	10.2	340	57	24	4.0	228	38
6	32	5.3	144	24	25	4.2	157	26
7	101	16.8	660	110	28	4.7	191	32

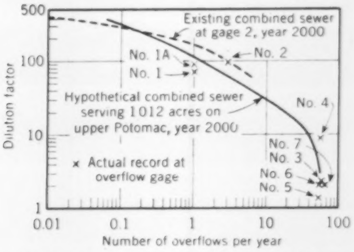


FIG. 3. Frequency of sewer overflows (from rainstorms only) is plotted against dilution factor. See text.

justifiable economically, to obtain the desired abatement of pollution in the Potomac above Rock Creek.

A similar computation was made for another sewer district, where Gage No. 2 was located, and the results are shown in Fig. 3, along with the actual data recorded by the overflow gages, using for the latter only the overflows resulting from rainstorms. As Fig. 3 seemed to present a good picture of overflow conditions, it was used as a guide in determining the desired dilution factor for other areas.

Recommended plan

After a study of alternate plans, the following dilution factors were adopted, for sewers overflowing into the various streams, based on conditions estimated for the year 2000:

Rock Creek	approx. 200
Potomac River:	
Upper (above vicinity of mouth of Rock Creek)	30
Below Rock Creek	5
Anacostia River	5

The dilution factor of approximately 200 for combined sewers which overflow into Rock Creek represents a storm of two-year frequency. It was desired to afford this stream in Rock Creek Park as much protection as economically practicable. The high dilution factor was obtained by planning a large "overflow sewer" (Fig. 2), to be located for the most part under the creek bed and to discharge into the Potomac River, which would take the flows from the tributary combined sewers in excess of that representing a factor of 30. Flows up to a dilution factor of 30 would go to the interceptors.

The upstream 2,600 lin ft of the "overflow sewer" would be located beneath the normally dry bed of Piney Branch, a tributary of Rock Creek. This part was given a capacity sufficient to provide for a 60-year rainstorm, to eliminate overflows into this stream, except on very rare occasions.

The factor of 30 was recommended for the upper Potomac, where there is no tidal action, so that this part of the stream can be used for recreation, including swimming. In line with this, it was recommended that the combined-sewer area adjacent to the upper Potomac be converted into a separate system, so as to eliminate sewer overflows in this vicinity.

The minimum factor of 5 was recommended for the tidal sections of the streams, as it was deemed impracticable to make these parts safe for swimming, and because the streams will satisfactorily assimilate without nuisance the resulting polluting matter discharged into them after the recommended improvements are made. The conversion to separate systems of two small combined areas tributary to these streams was recommended.

Estimated cost of this plan is $71,744,000, whereas the alternate plan would cost $238,000,000 as previously mentioned. The Board of Engineers concluded that the overflow-reduction plan was realistic in maintaining a balance between degree of pollution abatement and first cost, that it would give relatively prompt relief from pollution, and that the construction work involved would not be too inconvenient to the people of Washington. Therefore, this plan was recommended rather than that of separating all the combined systems.

(Part 2 of this article, to appear in a subsequent issue, will include quantities and characteristics of sewage, design criteria for conduits, and the design of the $18 million enlargement to the sewage treatment plant.)

TABLE II. Summary of overflows to streams during dry weather

Location, Gage No.	Dry-weather overflows during 12 months: Total No.	Duration, hr.: Total	Duration, hr.: Av. per occurrence	Month and No. in Month
3	16	184	11.5	July (15) Aug. (1)
5	30	162	5.4	May (2) June (13) July (8) Aug. (7)
7	65	476	7.3	May (2) June (16) July (20) Aug. (20) Sept. (7)

TABLE III. Estimated number and duration of overflows for various dilution factors

For combined sewers serving 1,012-acre combined districts, year 2000

Dilution Factor	Intensity of Rainfall, in. per hr	Weighted av. no. of overflows*: Summer †	Winter ‡	Year	Total duration of overflows, hr *: Summer †	Winter ‡	Year
3	0.038	26	30	56	100	135	235
5	0.057	24	26	50	84	98	182
7	0.075	23	23	46	70	70	140
10	0.101	20	18	38	55	45	100
20	0.19	12	7	19	23	11	34
30	0.28	7	3	10	12	2	14

* Based on zero runoff from isolated rainfalls of 0.01 to 0.02 in., and from first 0.02 in. of any rainfall. Thus, for a dilution factor of 3, data are based on runoff from 0.018 in. of rain per hr (0.038 minus 0.02).

† "Summer" is May to Oct. inclusive.

‡ "Winter" is Nov. to Apr. inclusive.

Greater New Orleans Bridge completed

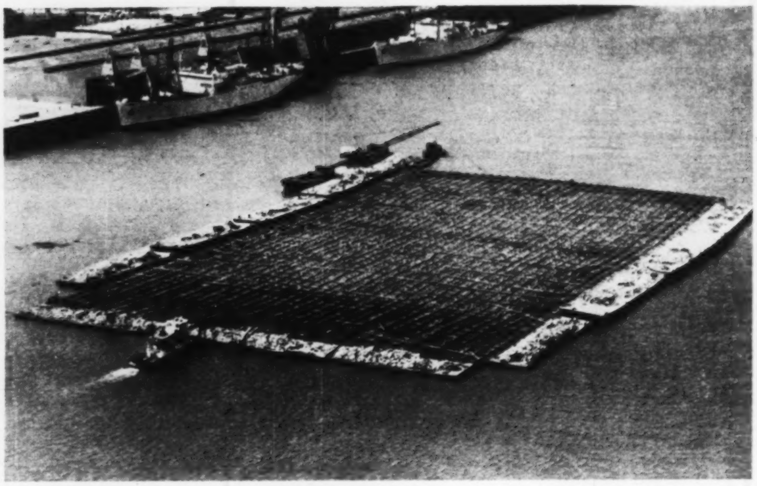
O. F. SORGENFREI, M. ASCE, Associate and Project Engineer, Modjeski and Masters, New Orleans, La.

With the opening to traffic of the Greater New Orleans Bridge on April 15, the Lower Mississippi River was spanned once more—farther downstream than ever before. While this in itself is significant, it is even more important that the 1,575-ft main span is the longest cantilever in this country and is exceeded in length only by the two 1,710-ft spans of the Firth of Forth Bridge and the 1,800-ft main span of the Quebec Bridge. The Greater New Orleans Bridge has the longest cantilever span of any highway bridge, and the longest of any bridge erected purely by the cantilever method without falsework supports for the main span. [Initial work on the pier foundations was described by Carl B. Jansen, M. ASCE, in Civil Engineering for February 1956, pp. 40-44.]

While this bridge connects New Orleans proper, on the east bank, with a smaller section of the city (Algiers) across the river, its name actually is derived from the fact that it is the principal link in a system of expressways and highways designed to serve this metropolitan area. As such, it provides not only the first convenient access between the two banks (previously provided by ferries) but stimulates the growth of the communities served, particularly those on the west bank.

The idea of a bridge across the Mississippi River at the City of New Orleans did not originate with the conception of this new metropolitan expressway system. The vision of a bridge here was century-old, and engineers had made specific plans for one as early as 1892, formidable as the task may have seemed, and actually was at that time and for many years thereafter.

When the present expressway system was planned, a crossing near the heart of the city became a necessity. The Louisiana Department of Highways then began studies for a definite location. Much planning and negotiating ensued to satisfy the requirements for navigation and the requirements of the Board of Commissioners of the Port of New Orleans, which operates many miles of wharves in the city. Impetus was given to the effort in 1952 with the organization of the Mississippi River Bridge Authority as an agency of the state empowered to construct and operate a bridge.



Stones weighing from 10 to 100 lb are hand carried from barges out on 300 by 500-ft willow fascine mattress anchored over site of Pier II. Mattress is loaded uniformly and sunk by rapid overloading, beginning at upstream edge.

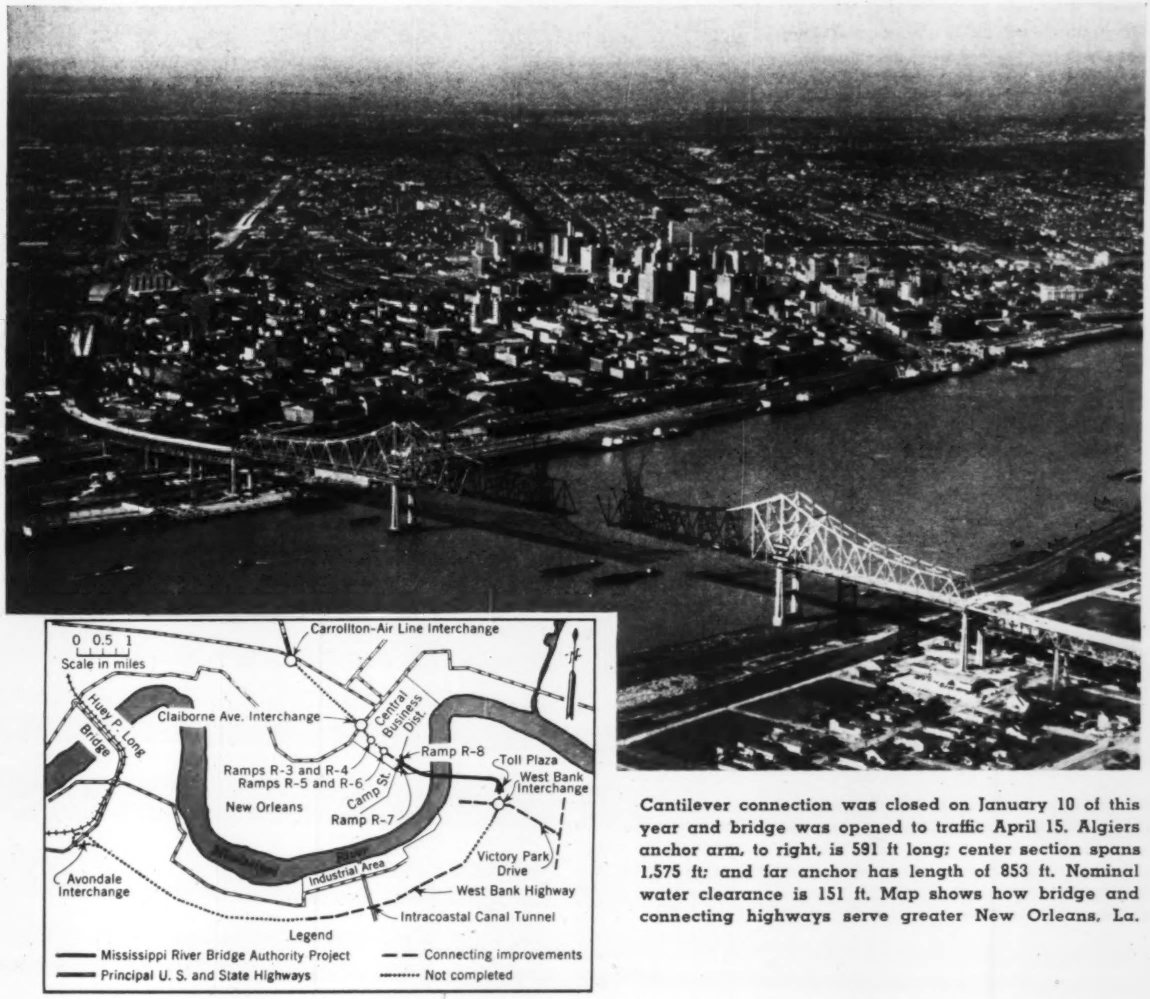
The final plan provided for a cantilever-type crossing, consisting of a 1,575-ft main span flanked by an 853-ft anchor arm crossing the wharf on the New Orleans side and a 591-ft anchor arm on the Algiers side (the west bank). It placed one main pier on the west bank and the other 580 ft out from the wharf line on the other side. The vertical clearance is 170 ft above mean sea level and 150 ft above high water.

Immediately flanking the river-crossing cantilever on each side is a series of deck-trusses with a maximum span of 327 ft, on reinforced concrete piers. Approaches to the high bridge are of steel tower and bent construction on a 3.5-percent grade.

Roadway width for the entire structure is 52 ft, providing two lanes of traffic in each direction initially. A reversible fifth lane is a possibility when the need develops, using directional lights.

The bridge is located about one mile upstream from the business district. The project starts at Camp Street in New Orleans (see map above), where it connects directly to the Pontchartrain Expressway and to city streets, and ends at the toll plaza in Algiers, 2.3 miles distant, where it connects to the Victory Drive Interchange and the new West Bank Highway.

In recent geologic time, the Mississippi River at New Orleans has migrated from a position back of the New Orleans levee to its present location, filling in the older bed with sand. Anchor Pier I of the bridge is founded at El. − 65, in the firm sand thus deposited. River Piers II and III are much deeper, founded in Pleistocene clay that is more


0 0.5 1
Scale in miles
Carrollton-Air Line Interchange
Huey P. Long Bridge
Claiborne Ave. Interchange
Central Business Dist.
Ramps R-3 and R-4
Ramps R-5 and R-6
Ramp R-8
Toll Plaza
West Bank Interchange
New Orleans
Camp St.
Ramp R-7
Mississippi River
Industrial Area
Victory Park Drive
Avondale Interchange
West Bank Highway
Intracoastal Canal Tunnel
Legend
Mississippi River Bridge Authority Project
Principal U. S. and State Highways
Connecting improvements
Not completed

Cantilever connection was closed on January 10 of this year and bridge was opened to traffic April 15. Algiers anchor arm, to right, is 591 ft long; center section spans 1,575 ft; and far anchor has length of 853 ft. Nominal water clearance is 151 ft. Map shows how bridge and connecting highways serve greater New Orleans, La.

than 10,000 years old, although the alluvial deposits above the clay are recent. Pier II on the New Orleans side, located about 580 ft out from the face of the recently constructed Thalia Street wharf, is founded at El. −180; and Pier III, located 120 ft riverward of the levee on the Algiers side, at El. −165.

Extensive test borings and soil tests were made at the site of each main pier, at depths varying from 250 to 400 ft. Undisturbed samples of the cohesive materials encountered were tested in two laboratories. At the founding levels, the clay is generally gray in color, is stiff, and has an unconfined compression strength varying from 4,000 to 8,000 psf. The moisture content averages about 27 percent, between the plastic limit of about 20 percent and the liquid limit of about 60 percent.

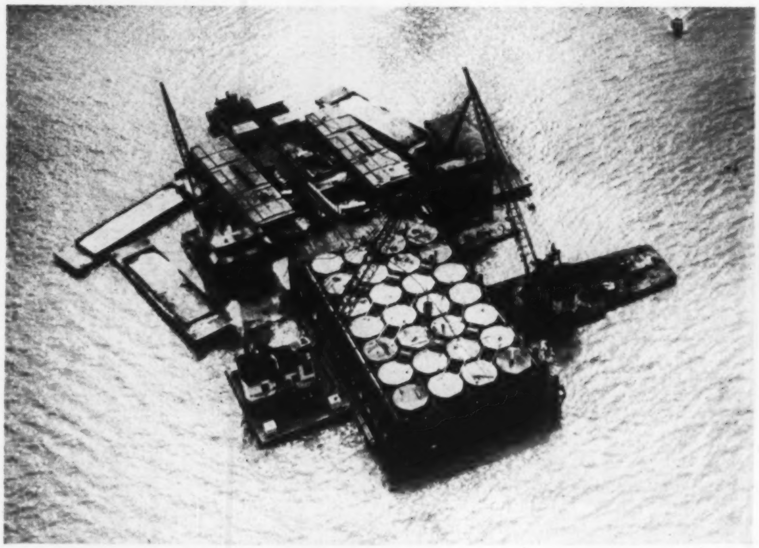
Based on these test results, it was decided to limit the net additional dead-load plus live-load pressures to about 2.5 tons per sq ft, but to allow the net additional pressure under dead-load plus hurricane wind to reach approximately 3.5 tons per sq ft. This "net additional pressure" is the gross buoyant pressure at founding level reduced by the buoyant pressure of the surrounding earth.

Caissons for Piers I, II and III were designed to be sunk by open dredging methods. The depths of Els. − 180 and − 165 for the river piers are far beyond the permissible pressure range for work in pneumatic caissons. Caissons for Piers I and III, on land, were designed to be set up as steel cutting edges on the ground and built up from there. Pier IV, the Algiers anchor pier, is founded on timber piles. Piles under the approach spans are also of timber, except for the cast-in-place concrete piles used under the New Orleans deck-truss spans.

Some settlement of the piers is expected; the pier tops have been set somewhat high to compensate for this as was done on the Huey Long Bridge. However, these settlements can cause no stresses in an articulated cantilever.

The bridge is designed for H20-S16 live loading. Because New Orleans is in a hurricane belt, a wind loading at 70 psf is included at stresses 40 percent above basic in combination with dead load. For a main-span length of the magnitude of 1,575 ft, somewhat higher unit stresses are employed in the trusses than are used in short-span bridges covered by standard specifications. Thus, 20,000 psi was used for A7 structural steel, but a minimum yield point of 36,000 psi was specified.

To reduce weight in the long spans, a high-strength steel is also used where advantageous in truss members, for which the allowable stress is 30,000 psi and the yield point 50,000 psi. Column sizes are enormous, reaching a total area of 462 sq in. for the largest member.



Guide stall formed by 39 pipe piles of 36-in. diameter holds caisson for Pier II. Dredging wells are covered during placing of concrete, supplied from two floating mixing plants.

The 1,575-ft main span was designed to be erected by the pure cantilever method from both tower piers to closure at the center of the main span, without falsework supports for the main span. The total amount of steel in the cantilever river section is 34,200,000 lb.

The approaches are more or less conventional in design and construction, the unusual construction features being in the river crossing. In the foundation work, the problems at Pier II were most interesting and difficult. The floating caisson is 88 by 151 ft in plan, among the largest ever built. It contains 28 dredging tubes, 18 ft in diameter, arranged in four lines of seven each. These are filled above the seal with water only to keep down the weight and soil pressure, even though the total gross buoyant load of bridge and pier at its base is 67,000 tons. The pier is larger on all sides below the river bottom than above. This provides a greater base spread without increasing the rate of river flow and consequent scour.

The over-all height of Pier II from its base at El. — 180 to the top of the reinforced concrete bent which comprises the pier shaft is 342 ft. Above this towers the structural steel truss to El. — 362, a total distance of 542 ft above the pier foundation.

Center pier, key to schedule

The center pier, located some 580 ft out from the Thalia Street wharf in a 70-ft depth of water at low river stage, was the key to the construction schedule. Willow mattress construction, for instance, had to be scheduled for the low-water season. This mattress was designed to provide permanent local stabilization of the river bed and, temporarily, to maintain a predredged, level area upon which to land a floating caisson. To take advantage of the latter provision the contractor, Dravo Corporation, placed this protection before the start of pier construction. This scheduled the beginning of operations in the summer of 1955.

A stage of 6 ft or lower, referred to Mean Sea Level, was considered necessary for successful sinking of the mattress. Harbor traffic prevented weaving of the mattress, 300 by 500 ft in size, at the site. The Corps of Engineers stipulated a weaving site not closer than the Huey P. Long Bridge, nine miles upstream. Consequently the contractor decided to weave it at the source of the live willow supply near Plaquemine, La., some 90 miles upstream, and to tow it to the site. While harbor conditions would have permitted woven sections to be assembled at the site, and contract specifications permitted the sinking and overlapping of partial sections, the contractor elected to build and sink the mattress as one unit, full size.

The mattress was successfully floated down the river and anchored in place in September 1955. Upon arrival it was maneuvered into position above its planned river-bottom location and held in all directions by long anchor cables. It was then ballasted with 10-lb to 100-lb stone until it was barely buoyant. After a final location adjustment, which allowed for drift as the cable angles changed, the mattress was sunk to the bottom quickly by overloading with additional stone, beginning at the upstream end. It landed within the 15-ft permissible tolerance.

Meanwhile the contractor had prefabricated the 20-ft-high steel cutting edge that was to form the bottom of the caisson. This 500-ton structure was built in the contractor's Pittsburgh plant on the Ohio River, launched sidewise like a ship or barge, and towed 1,900 miles to the site. While the mattress was being built and sunk, the height above the floating cutting edge was being increased with cofferdam sections consisting of 6-in. tongue-and-groove timber sheeting braced with steel members.

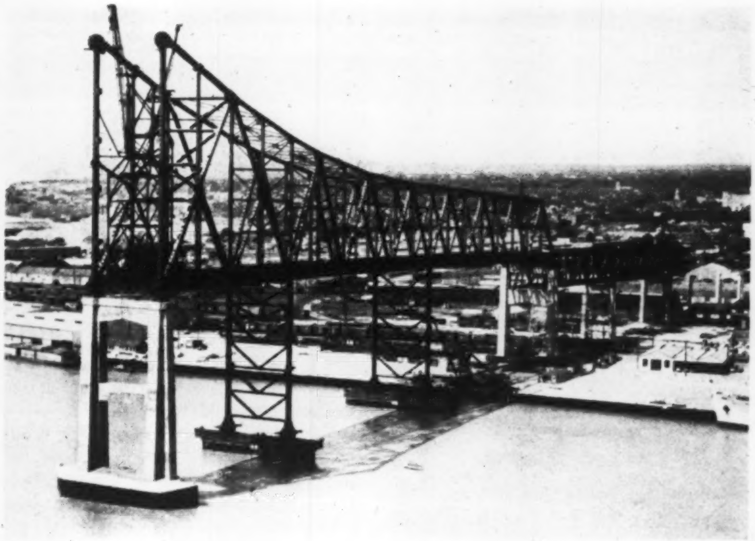
As soon as the mattress had been sunk and while the final 2-ft blanket of heavy riprap was being deposited on it, the contractor began construction of the "stall" that was to hold the floating caisson in accurate position. It consisted of a narrow U-shaped cage 40 ft deep supported by 39 pipe-piles of 36-in. diameter and 150 ft long. Accurate location of this stall was obtained by "lining up" one pile with transits on shore and then using this pile as a pivot in making the required final adjustment. Double I-beam guide spuds were then driven inside at the caisson corners, leaving one foot of clearance to be filled out with 12-in. timber, trimmed as required to provide a final 1-in. caisson clearance.

The caisson remained a free floating structure until it reached river bottom, its buoyancy being provided by voids formed by an outside cofferdam and by steel tubes inside forming the dredging wells. Roughly 50 percent of the plan area was thus open and dry.

Sinking of this 88-ft by 151-ft caisson was accomplished by simply placing concrete in the void area and extending it to cofferdams and tubes, as required to maintain freeboard. One foot of concrete would increase the draft about 2½ ft until, on landing, there was a difference in level of about 40 ft between the water surface and the concrete. After this stage the difference decreased.

The second sinking stage involved, in addition, the dredging of the river-bottom soils through the dredge wells. The caisson was now standing hard on the mattres. Since dredging the mattress up through the wells would have caused undue raveling beyond the caisson area, it was first cut cleanly along the caisson periphery, using a long, chisel-pointed 36-in. I-beam.

Sinking now fell into a pattern of alternate dredging and placing of additional concrete lifts with stops at intervals to extend the cofferdams and tubes. Dredging was done with two floating rigs using 2-cu yd clamshell-type buckets operating through the 18-ft-diameter



New Orleans anchor arm required four falsework bents for erection. A shore bent (removed) carried 1,200 ton load, spread on a grillage on Thalia Street Wharf. The two falsework bents shown rest on H-piles. The 100-ft-high traveler, supporting two derricks, is ready to erect main span.

pockets. The amount of concrete added depended on the weight needed to cause sinking while dredging. Insufficient weight would cause dredging to advance too far ahead of the caisson, inviting serious blow-ins of material. Too much weight would crowd the materials up into the dredge wells, resulting in a loss of control of direction. As long as concrete remained to be placed, the weight could be regulated.

Once all the planned concrete had been placed, the sinking operation was more or less "on its own." For successful sinking at this stage, the soils penetrated must have been properly evaluated to estimate the skin friction resisting sinking. There had to be sufficient weight to take the caisson the remaining distance to founding level. Yet excess weight would result in that much additional and unnecessary foundation load.

Fortunately in this caisson the ratio of buoyant weight to area of skin friction was such as to make the caisson sensitive to dredging operations, with the result that this 33,000-ton base was landed without some of the troubles often attending deep sinking of such caissons. In its 165-ft vertical height the caisson was plumb within 1¼ in., and its position was only 2 in. from that planned. This is much closer than the specified tolerances—and actually much closer than could have been hoped for. This accuracy is proof of the contractor's care and skill.

Final sealing of the caisson was accomplished in six separate tremie pours, facilitated by one longitudinal and two transverse cross-walls, which were designed into the working chamber for this purpose. The six compartments thus formed were cleaned out and sealed one at a time, to leave as much soil support as possible under the remaining part of the caisson until the seals were able to take the load. The sealing concrete was placed through a tremie pipe 200 ft long. In all, some 6,700 cu yd were required.

Construction of Pier III differed from that of Pier II in that it was principally a land operation. The caisson was started on the dry bank, which was covered with only a few feet of water at above-normal stages. Basic preparations consisted of replacing some of the soft bank material with compacted firm material, driving a line of steel sheetpiling for protection, and constructing a steel-framed dock. On this were mounted two revolving, electric-powered traveling cranes.

The problem at this pier was to sink the caisson 174 ft on the sloping river bank. The caisson base, 61½ ft by 135 ft, was started in exact plan position and this was maintained throughout sinking, with slight variations, until the founding elevation was reached. The difference in lateral pressures due to the sloping bank proved insufficient to cause drifting toward the river, as sometimes occurs. The unequal pressure did not cause any tipping; the caisson landed plumb within 3 in. in its 167-ft height. The average sinking rate was 10 in. per day.

Bridge superstructure erected

Of equal significance was the erection of the 17,000-ton main bridge superstructure. While the procedure was conventional, equipment, erection bents, and details were of unusual proportions.

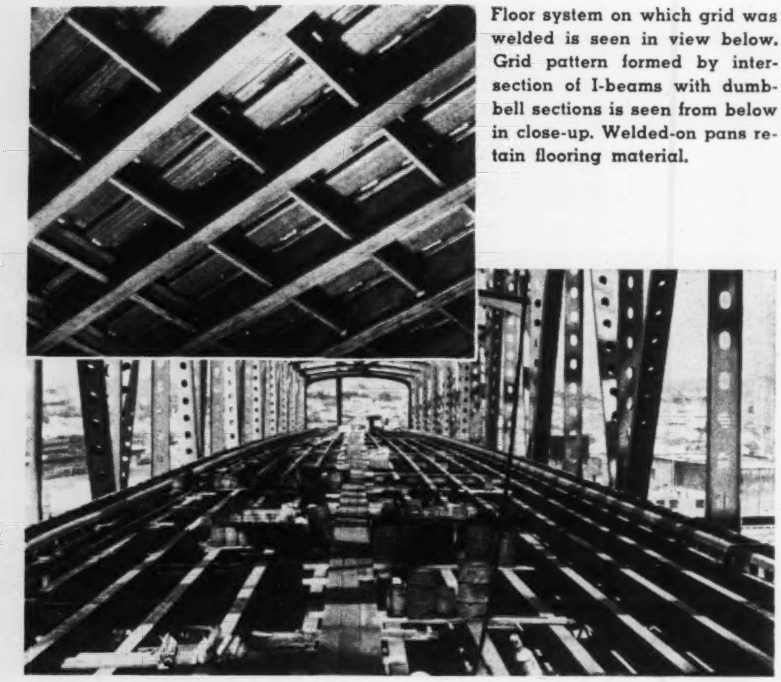
Balanced erection about the main piers was considered unsafe because of the large torsional stresses that could result in the piers from unequal wind loads on the long projecting arms. Hence falsework bents were required under the anchor arms as erection proceeded from the anchor piers.

Large tower travelers were needed to erect the members, which rose as high as 200 ft above the deck at the main pier. The travelers were mounted on the floor system, and their tower bases rose 100 ft from floor to base of boom. Here a stiff-leg derrick, of 115-ton capacity with 115-ft boom, was mounted forward for erection of all heavy members. At the rear a 25-ton stiff-leg derrick was used for filling in bracing members and assisting with eyebar erection. Special, heavy stringers were required to support the travelers. Hoisting engines were mounted within the tower structure until erection had proceeded well out on the cantilever; they were then set down on the bridge floor and operated with extended cables to reduce equipment weight. When over land, the travelers picked up members directly from the ground; over water they took the steel from barges anchored below. The heaviest member, a top chord, weighed 93 tons.

While New Orleans soils are noted for their lack of stability, sufficiently firm soils occur near the river to permit a falsework load of one ton per square foot. Land bents were supported on spread footings; the two bents required in the river under the New Orleans anchor arm were supported on long steel bearing piles. Falsework bents consisted of heavy built-up braced legs, one under each truss.

Hydraulic jacks and shims were incorporated in the bents to provide for final height adjustment and for any adjustment made necessary by base settlement. The maximum settlement of any land bent was 6 in. Good bearing capacities were obtained in the steel piles of the river bents although lengths up to 180 ft were required. The largest false-work load, without wind, was 3,100 tons, carried by the first river bent.

Of unusual interest was a land bent that happened to come in the wharf area. Rather than open up the wharf floor for a pile-supported base, the contractor spread the 1200-ton bent load over a sufficiently large area to permit the reinforced concrete floor, supported



Floor system on which grid was welded is seen in view below. Grid pattern formed by intersection of I-beams with dumbbell sections is seen from below in close-up. Welded-on pans retain flooring material.

on structural framework, to support the load. This required a grillage base of considerable size, carefully shimmed to produce uniform final loads at selected points as the grillage beams deflected.

As mentioned before, the main span was erected entirely by the cantilever method. Erection progressed from each pier to a closure point at the center of the span. Material barges were anchored directly under the derricks.

As erection approached the ends of the cantilever arms, two 800-ton hydraulic jacks were placed in each top and bottom chord for final adjustment and closure. These jacks, and safety shims, were so adjusted as to position the cantilevered halves of the suspended span at the point of closure above geometric grade, and further, were retracted a sufficient amount to leave a safe erection opening for temperature variation until closure time.

After all steel had been erected except such bracing as had to await removal of the derricks, the two halves of the 3,000-ton suspended span were gradually pushed together and connected.

The closing operation, while simple in detail, called for considerable skill and detailed planning of the sequence of operations. Constant checking was required to maintain alignment and grade while the two halves of the suspended span were brought together. Telephone communication was used to coordinate operations at the eight jacking points. Temperature movements had to be considered in the amount of $\frac{1}{8}$ in. per deg F. Once one of the six principal connections was made, the operation had to be carried through to conclusion, for the expansion joints at the ends of the cantilever arms would not function until the jacks were released.

All closing steps were successfully carried out as planned, in a period of seven hours on January 10, 1958. Then, when the jacks were released, the suspended span hung free as designed.

In addition to the reduction of dead load through the use of high-strength steel, further decrease in weight was effected by the use of a steel grid floor overlaid with asphalt. This was used in the long New Orleans anchor arm and in the main span. Principal carrying members of the grid are I-shaped beams 5 in. high with a 1-in. top flange and a $1\frac{1}{2}$-in. bottom flange placed transversely to the roadway centerline, on 9-in. centers. Dumbell-shaped crossbars for load distribution are threaded through holes in the upper part of the I-beams on 8-in. centers. These bars are welded at each beam. The grid is supported on roadway stringers spaced at 4-ft 4-in. centers.

A corrugated steel plate, $\frac{5}{32}$ in. thick, is welded over the top of the grid. The plate is so formed as to leave a flat surface, with the corrugations consisting of two depressions each one inch deep and two inches wide, between each pair of I-beams. The flat upper surface rests on the I-beams, and the depressions on the crossbars. The grid was fabricated in sections 26 ft long and about 6 ft wide, cambered, ready to be welded to the roadway stringers.

The wearing surface consists of a layer of bituminous concrete $1\frac{1}{2}$ in. thick over the upper flat-plate surface. Slag aggregate was used for the leveling course, but for the surface course, the coarse aggregate consisted of a mixture of trap rock and crushed gravel for maximum stability and wearing properties. Since compaction of the material in the corrugations was of some concern, a test panel of surfacing was required to be placed to develop a satisfactory method for placing. Best results were obtained by using both steel-wheeled and rubber-tired rollers, the compaction in the corrugations being accomplished almost entirely by the latter.

The lightweight floor was developed particularly for these long spans. Its unit weight, including surfacing, is 45.5 lb per sq ft. After it had been in service a month, an inspection revealed that it was performing as expected.

The bridge, its approaches and toll collection facilities are being constructed under thirteen major contracts. The two largest ones are that held by Dravo Corporation for $6,691,590 for the four main bridge piers, and that held by Bethlehem Steel Company for $12,268,580 for the river-crossing cantilever superstructure. Bethlehem Steel Company also holds contracts for the approach superstructures. Boh Brothers Construction Company built all approach substructures, and Keller Construction Corporation, the toll collection facilities. The total construction cost of the bridge proper will exceed $37,000,000.

Construction began in March 1955 and the bridge was opened to traffic on April 15, 1958. While the entire expressway is not complete, the bridge and its limited connections are serving a current need.

The bridge was constructed by the Mississippi River Bridge Authority, of which Captain Neville Levy is chairman and Messrs. William O. Turner, Alvin T. Stumpf, Richard W. Freeman, Robert L. Simpson, John W. Stone and W. Richard White are members. Funds for the construction of the entire project were provided by a $65,000,000 revenue bond issue, supplemented by allocations from state highway funds.

Modjeski and Masters designed the bridge and facilities and are also supervising construction for the Authority. The writer was project engineer at the site.

ENGINEERS' NOTEBOOK

Wind loading tests on aluminum sign supports

J. F. O'KEEFE and E. D. GARDNER, Product Development Department, Reynolds Metals Company, Louisville, Ky.

Among the highway accessories for which aluminum is being widely used are signs for superhighways. It has been estimated that, in the next decade, as much as 500 million pounds of aluminum may go into such highway accessories as signs, railings, and lighting standards. A recent price reduction may stimulate such use.

In the design of large aluminum signs for superhighways, allowance must be made for several factors not encountered with ordinary highway signs. Signs must be placed so as to be legible for considerable distances, and many will require a large sign area. This area and their exposed position make such signs doubly susceptible to wind attack.

To check calculated loadings and mechanical design of various types of supports for aluminum superhighway signs, Reynolds Metals Company (which incidentally developed the new extruded interlocking panels for highway signs) arranged for a series of tests on actual signs under simulated wind loadings up to and including wind velocities of 105 miles per hour.

The wind loading tests were run at the University of Miami's Hurricane Test Station under the supervision of A. A. Sakhnovsky, Director of the Housing Research Laboratory. See Table I for details of the support systems tested. The aluminum alloy was 6063-T6, which had the following typical properties: ultimate strength, 35,000 psi; yield strength, 30,000 psi; and elongation, 12 percent.

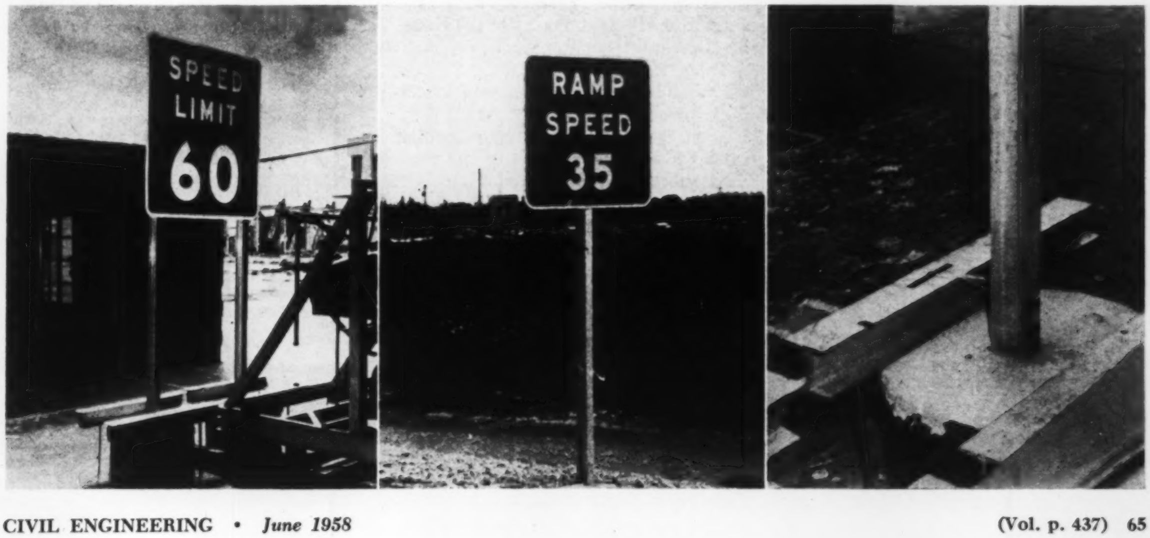
The wind generator was a 1,200-hp aircraft engine. At increasing distances from the generator the air stream broadens and the wind intensity decreases. To achieve a maximum wind velocity of 105 mph against a sign it was necessary to limit the sign area to 16 sq ft (4 x 4 ft). Test wind velocities ranged from 30 to 105 mph.

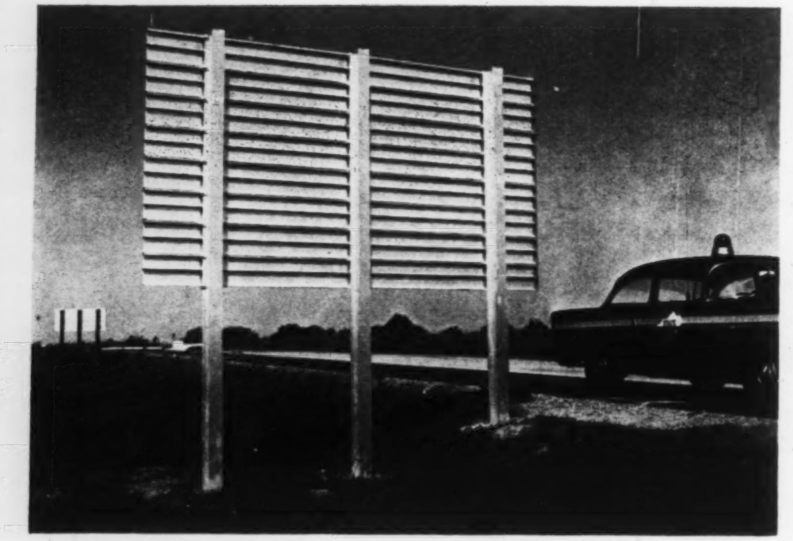
Single supports for the signs were centrally mounted; twin supports were placed 6 in. from each edge. The aluminum supports were cast in portable concrete cylinders 23 in. in diameter and 14 in. deep, and the cylinders were clamped to a concrete floor. A wind velocity survey was made before the test to calibrate sign location against engine speed (rpm). For the length of the sign support between the floor and the base of the sign, 54 in. and 72 in. were selected as average sign heights.

Signs were oriented at several angles to the wind stream, measured by the angle (in degrees) to the centerline of the wind generator. Strain gages were mounted at the base of the support, just above the concrete line, on the extreme edge of the flange section, as shown in a photograph. Stress measurements were made for each increment of loading.

Results of the tests are given in Table II. In Test 1, it is evident that the single 4-in. I-beam did not possess the required strength to support the 4 x 4-ft sign at either the 54- or 72-in. height. With wind velocities of 40 to 50 miles

Sheet sign 4 ft square mounted on two 4-in. I-beams (left) is being tested. Similar sign on Florida Sunshine Parkway (middle) is mounted on single 4-in. H-beam. At right, strain gages are attached to base of 4-in. I-beam sign support.





Interlocking extruded aluminum panels of Reynolds Metals Co. are bolted to aluminum I-beams to provide sign with good wind resistance.

per hour a resonant vibration developed in the sign assembly and caused severe oscillations. After 3 or 4 min at this load the flange on the supporting beam developed a crack. Under the severe oscillation the sign face twisted as much as 40 deg from normal and the side-to-side motion at the top of the support was about 10 in.

In contrast to the 4-in. I-beam, the single 4-in. H-beam proved to be a satisfactory support. Strain measurements taken at the base showed a low stress concentration. The angle of twist with a 105-mph wind did not exceed 10 deg from normal. The side-to-side motion was slight, although at high wind velocities there was a small flutter at the edge of the sheet sign.

The double 4-in. I-beam support developed the least stress of the supports tested. The front-to-rear motion at a 105-mph wind was slight. There was slight twisting. The double 3-in. I-beam support was very similar in behavior to the double 4-in. I-beam although the stress measured at the base was slightly higher.

The ratings describing the motions of the sign are arbitrary and are the observations of Mr. Sakhnovsky of the Housing Research Laboratory.

Table II shows the maximum stress vs. wind load. All loading was in the X-X plane. However, the single 4-in. I-beam received its maximum loading in the Y-Y plane because of the resonant vibration encountered.

It is concluded that a single aluminum 4-in. H-beam is a satisfactory support for 4-ft x 4-ft sheet signs at wind velocities of 105 mph. With single 4-in. I-beams, a resonant vibration started in the sign assembly and caused severe oscillations and ultimate support failure at 50 mph.

Double supports of either 3-in. I-beams or 4-in. I-beams showed lower stress concentrations than single 4-in. H-beams and reduced flutter at sign edges.

Table I. Details of support systems tested

Test No.	Support	Distance Between Footing and Sign
1	Single 4-in. I-beam	72 in.
2	Single 4-in. I-beam	54 in.
3	Single 4-in. H-beam	54 in.
4	Two 4-in. I-beams	54 in.
5	Two 3-in. I-beams	54 in.

Elements of Sections

	3-in. I-beam	4-in. I-beam	4-in. H-beam
Weight per ft, lb	2.31	3.03	4.85
Area, sq in.	1.91	2.50	4.00
Web thickness, in.	0.251	0.253	0.312
$X-X$ axis:			
I	2.71	6.40	10.72
S	1.80	3.20	5.36
V	1.19	1.60	1.64
$Y-Y$ axis:			
I	0.51	0.82	3.56
S	0.42	0.61	1.78
V	0.52	0.57	0.94

TABLE II. Test results

Wind Veloc. mph	Duration min.	Side-to-Side Motion	Twisting	Max. Stress Reading at Base
TEST 1. One 4-in. I-beam, sign 72 in. high, wind stream 90 deg to sign face:				
30	2	Considerable	Considerable	1,460 psi
40	3	Severe	Severe	16,400 psi
*50	8	Very severe	Very severe	27,300 psi
TEST 2. One 4-in. I-beam, sign 54 in. high, wind stream 90 deg to sign face:				
30	1.3	Slight	Slight	3,160 psi
40	1.7	Considerable	Considerable	34,000 psi
50	1	Severe	Severe	†39,500 psi
TEST 3. One 4-in. H-beam, sign 54 in. high, wind stream 90 deg to sign face:				
20	2	Very slight	Nil	840 psi
40	1.5	Very slight	Nil	1,150 psi
50	1.5	Very slight	Nil	1,890 psi
65	1.5	Slight	Nil	2,640 psi
80	1.5	Slight	Nil	3,890 psi
95	1.5	Slight	Very slight	5,670 psi
105	7	Slight	Very slight	10,700 psi
TEST 4. One 4-in. H-beam, sign 54 in. high, wind stream 45 deg to sign face:‡				
30	1	Nil	Very slight	1,050 psi
40	1	Trace	Very slight	1,680 psi
50	1.5	Very slight	Very slight	2,820 psi
65	0.7	Very slight	Slight	3,680 psi
80	1.3	Very slight	Slight	4,950 psi
95	1	Very slight	Slight	5,470 psi
105	3	Slight	Slight	7,890 psi
TEST 5. Two 4-in. I-beams, 35 in. apart, wind stream 90 deg to sign face: §				
35	1.7	Nil	Trace	840 psi
40	1.7	Nil	Trace	1,520 psi
50	1.5	Nil	Very slight	1,790 psi
65	1.5	Trace	Very slight	2,620 psi
80	1	Very slight	Slight	4,000 psi
95	1.3	Very slight	Slight	6,000 psi
105	7.5	Slight	Slight	8,700 psi
TEST 6. Two 3-in. I-beams, 36 in. apart, sign 54 in. high, wind stream 90 deg to sign face:¶				
30	1.7	Nil	Trace	1,360 psi
40	1	Nil	Trace	2,100 psi
50	1.3	Nil	Very slight	3,050 psi
65	1.5	Nil	Very slight	5,160 psi
80	2.3	Nil	Slight	7,050 psi
95	1	Nil	Slight	9,200 psi
105	1.5	Very slight	Slight	12,600 psi

---

* Test was stopped when a crack developed in front flange.

† This value is not exact as gage broke when load passed the yield. Small crack developed at edge of flange.

‡ Motion was not as severe as in Test 3.

§ Front-to-back motion at 105 mph was estimated at ¾ in. or a little more. Back flange showed some side-to-side motion as though it were twisting around front flange.

¶ Front-to-back motion at 105 mph was estimated at ½ in. Behavior of this support was similar to double 4-in. I-beams.

Solving the secant formula

ALFRED GORDON, A.M. ASCE, Engineer, St. Lawrence Seaway Authority, Montreal, Canada

For structural steel columns with fixed ends, with bending about the weaker axis, the secant formula of the American Railway Engineering Association is a valuable tool. When recently I had occasion to use this formula for the first time, I had forgotten, or on short notice could not find, such charts as would have been helpful in its solution. I therefore had to make my own, here presented in Fig. 1.

A subsequent examination of other charts left me with the impression that in some of them too much had been attempted. As a result a good deal of preliminary calculation was required and the many lines on the chart were confusing. The nomograph here presented is for only one set of conditions, but it is simple and complete in itself. This means that errors are less likely to be introduced.

The secant formula for columns with fixed ends and with bending around the weaker axis only, from AREA Manual, Chapter 15-1-42, is:

$$p = \frac{18{,}750}{1 + C_1 \sec 0.0000917517 \dfrac{l}{r_1}\sqrt{\text{p}}}$$

in which $C_1 = \left(\dfrac{e_1c_1}{r_1{}^2} + \dfrac{1}{4}\right)$

l = length of column, inches

p = allowable average compressive unit stress, psi

e_1 = eccentricity of load in direction r_1, inches

e_2 = eccentricity of load in direction r_2, inches

r_1 = radius of gyration, inches, about weaker axis

r_2 = radius of gyration at right angles to r_1

c_1 = distance from neutral axis to extreme fiber in direction of r_1, inches

c_2 = distance from neutral axis to extreme fiber in direction of r_2, inches

In this case the modulus of elasticity, $E = 29{,}400{,}000$, and the extreme-fiber-stress permissible in compression is $y/f = 33{,}000/1.76 = 18{,}750$ psi, which includes buckling effect.

The complexity of the secant formula itself, and of some of the graphical solutions for it, have stood in the way of its general use. I have found that the use of the secant formula saves metal by a more exact design of sections. To facilitate plotting of the curves needed, the nomograph here presented should be helpful as an example.

$$\text{Let } 0.000091751 \left(\frac{l}{r_1}\right)\sqrt{p} = \alpha_1 \quad \text{. . (1)}$$

$$\text{Then } C_1 \sec \alpha_1 = \frac{18{,}750 - p}{p} \quad \text{. . . . (2)}$$

As for Eq. 1, it is plotted in the first Z-chart on the extreme left of Fig. 1 (See *Nomography*, by A. S. Levens, Wiley 1948, pp. 43–58.) The upper scale of this chart and the first perpendicular scale are the axes for a graph of sec α, permitting the construction of the second (and adjacent) Z-chart, corresponding to Eq. 2.

In similar fashion, for the complete formula we obtain

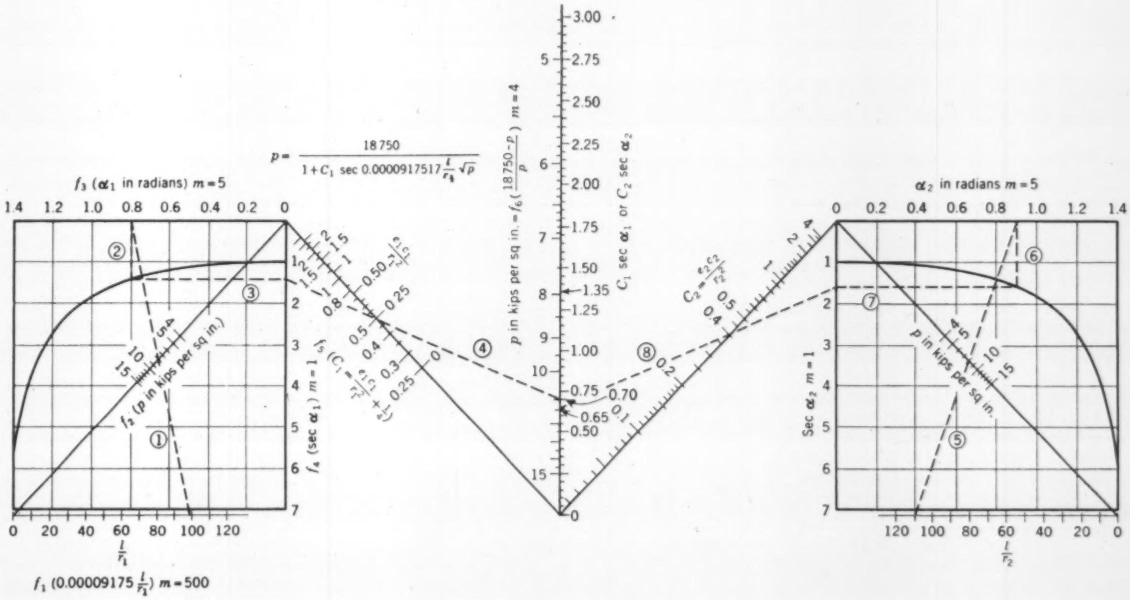
$$C_1 \sec \alpha_1 + C_2 \sec \alpha_2 = \frac{18{,}750 - p}{p} \quad \text{. . (3)}$$

and the nomograph becomes symmetrical about the central (vertical) scale, except that C_2 is $e_2c_2/r_2{}^2$ and α_2 is $0.000091751\ (l/r_2)\ \sqrt{p}$.

Example solved

To illustrate the use of the nomograph, assume a column in which $l/r_1 = 98$; $l/r_2 = 110$; $e_1c_1/r_1{}^2 = 0.25$; and $e_2c_2/r_2{}^2 = 0.40$. Assume that the safe unit com-

FIG. 1. This nomograph illustrates graphic method of solving AREA secant formula for structural steel columns.


$p = \frac{18750}{1+C_1 \sec 0.0000917517 \frac{l}{r_1}\sqrt{p}}$
f_3 (α_1 in radians) $m = 5$
1.4 1.2 1.0 0.8 0.6 0.4 0.2 0
① ② ③ ④ ⑤ ⑥ ⑦ ⑧
f_2 (p in kips per sq in.)
15 10 5 4
f_4 (sec α_1) $m = 1$
1 2 3 4 5 6 7
f_5 ($C_1 = \frac{e_1c_1}{r_1^2} + \frac{1}{4}$)
$\frac{e_1c_1}{r_1^2}$
0 0.20 40 60 80 100 120
$\frac{l}{r_1}$
f_1 ($0.00009175 \frac{l}{r_1}$) $m = 500$
p in kips per sq in. $= f_6(\frac{18750-p}{p})$ $m = 4$
C_1 sec α_1 or C_2 sec α_2
3.00 2.75 2.50 2.25 2.00 1.75 1.50 1.35 1.25 1.00 0.75 0.70 0.65 0.50 0
$C_2 = \frac{e_2c_2}{r_2^2}$
α_2 in radians $m = 5$
Sec α_2 $m = 1$
p in kips per sq in.
$\frac{l}{r_2}$

pressive stress, p_1, is 8 kips per sq in. Then, on the left half of the nomograph, Line 1, drawn through the given value of l/r_1 and the assumed value of p, gives $\alpha_1 = 0.8$ radians. Lines 2 and 3 give the value of sec $\alpha_1 = 1.4$. Line 4, through the value of sec α_1 just found, and 0.25 on the diagonal scale for e_1c_1/r_1^2, gives 0.70 as the value of C_1 sec α_1.

In the same way, Lines 5 to 8 give us 0.65 as the value of C_2 sec α_2. Add C_1 sec α_1 to C_2 sec α_2, that is, add 0.70 to 0.65, and obtain 1.35, which corresponds to a load p of 8 kips per sq in., which was the value assumed in drawing Lines 1 and 5. Therefore $p = 8$ kips per sq in. is the solution of the formula. If there had not been this correspondence, then another value of p would have had to be assumed, and the whole operation repeated until the final and the assumed values of p came out the same.

It should be noted that if there is no bending about the stronger axis, then Eq. 3 becomes identical with Eq. 2, since the term involving e_2 in the secant formula becomes zero—that is, C_2 is zero. This means that when the bending is about the weaker axis only, then only the left half of the nomograph is required. It does *not* mean that in this example p would be 11 kips per sq in., but it *does* mean that Lines 1 to 4 must be drawn so that the value of p corresponding to C_1 sec α_1 on the central scale is the same as the value of p assumed in drawing Line 1. Note that C_1 can never become zero.

When the bending is about the weaker axis only, it is easy to obtain from the left-hand half a set of curves relating p and l/r_1 with e_1c_1/r_1^2 as parameter. In fact the germ of the complete nomograph lay in the need for such a set.

Pin-end columns

An additional scale for the values of l/r can be added so that the chart can be used as readily for pin-end columns. After drawing the nomograph for riveted-end columns, divide the scales for l/r from zero to 70 into six spaces. This means that 70 for riveted ends becomes 60 on the scale for pin ends, from which, as the l/r scales are uniform, the whole scale can be drawn. The same result can be secured without any new scale, simply by multiplying each l/r by 7/6 before using it in the nomograph as shown.

The moduli of all vertical and horizontal scales are given. Those for the diagonal scales can be obtained from the former as indicated in the textbook by Levens cited above. The lengths of the diagonals of the original chart were made 10 in. and the distance between the verticals 7 in. These particulars are given to aid those who may wish to reproduce this drawing or make a similar nomograph for other materials.

On the nomograph f is used as in the text cited, and with its subscripts, denotes the functions for which the scales are made. For example, f_1 $(0.0009175\, l/r_1)$ together with $m = 500$, means to evaluate the bracket and multiply by 500 for each value of l/r_1.

THE READERS WRITE

Would inverted stepped footings yield savings with safety?

DEAR EDITOR: The article in the February issue, "Inverted Stepped Footings for Savings with Safety," by Paul Rogers (p. 76), is certainly worthy of a few comments. The author should be commended for discussing a subject that usually is a matter of such routine that very little thought is given to it. Bringing up this subject of a more refined design of spread footings will help shed new light on some basic design procedures.

The author's statement that pedestals above the footing slab are usually objectionable can readily be accepted. However, his alternate suggestion of an inverted depressed footing contains a few design fallacies that ought to be corrected. In the light of these corrections it appears that the proposed inverted stepped footing neither constitutes a saving as compared with the conventional footing nor provides greater safety.

The major error lies in determining the shear force on the thinner portion that is to be used as a measure for diagonal tension. The critical section for the shear force would be in the position shown in Fig. 2 of the article only if the thicker portion of the footing had formed a pedestal above the thin slab (Fig. 1). But this is exactly what Mr. Rogers wants to avoid. In the footing he proposes, this critical section would be in the position shown in Fig. 2 by the dotted line rather than in that indicated by the faint solid line as in his article.

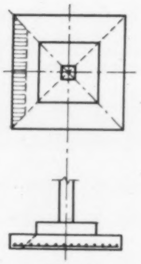


FIG. 1

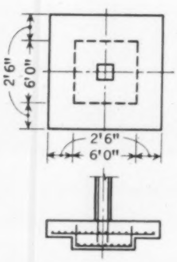


FIG. 2

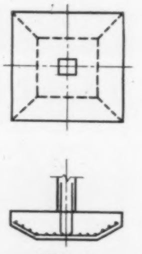


FIG. 3

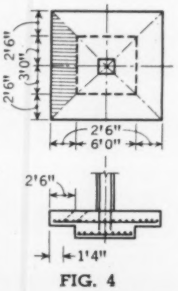


FIG. 4

This would nearly double the critical shear force for the thinner portion and make it:

$$V = 8.5 \times 2.5 \times 3.62 = 76.8 \text{ kips}$$

$$V = \frac{76{,}800}{6.0 \times 12 \times 0.87 \times 14} = 87.2 \text{ psi}$$

This stress is of course far above the allowable. To reduce it to 75 psi, the thinner portion would have to be increased to 1 ft 8 in. and the claimed reduction in actual shear stress is therefore unjustified.

Another consideration of importance is that only in extremely compact soil could such a stepped footing be excavated without substantially disturbing the soil at the step. Such disturbance seems undesirable since the stress distribution under the footing would then be far from uniform. But even if this consideration is brushed aside, such footings would require more hand excavation, which would more than offset the very slight saving in reinforcing steel.

Further it is questionable whether the proportions chosen for the depressed portion of Mr. Rogers' footing are desirable. It seems impossible to develop by bond in a relatively short length the tensile force in the steel, especially when No. 9 bars are used, as in that example. Smaller bar sizes would help, but the design should also take into account the stress concentration at the reentrant corner of the step. Unless this is actually computed, it would be structurally expedient to bend up the bars of the bottom portion as shown in Fig. 3. This, however, would completely erase any possible saving in reinforcing steel.

A structurally sounder approach toward savings in spread footings might be to use a section like that in Fig. 4. But it is still doubtful whether that shape would normally yield a saving as compared with the good old conventional type.

Incidentally the calculation of the minimum steel in the article under discussion is erroneous, but the correct figures would not change the results obtained there.

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Editor's Note: Similar comments have been received from Asst. Prof. Edward C. Holt, Jr., A.M ASCE, The Rice Institute, Houston, Tex., and members of the Rice Student Chapter.

TVA diversion dam designed for overtopping

To the Editor: In the April issue (p. 50), Messrs. Barr and Rosene point out the absence of recorded experience with loose-rock spillways for low-head dams. TVA had some difficulty with a rock-protected diversion dam designed to be overtopped by floods. A brief description of this dam and its behavior will probably be of interest.

The dam is rolled-earth fill, 15 ft high on 10 ft of overburden. The crest is 10 ft wide and surface slopes are 1 on 2. On the downstream side an outlet trench was excavated to rock, so the downstream face has a height of 25 ft. The upstream face is protected by light riprap on a filter layer. The crest and downstream face are covered by a rock blanket 5 ft thick made up of a two-zone filter 2½ ft thick, covered with a single layer of surface stones, also 2½ ft thick. The two zones of the filter were graded as follows:

Fine Filter			Coarse Filter		
Passing Sieve	% by Weight		Passing Sieve	% by Weight	
	Min.	Max.		Min.	Max.
1¼ in.	90	100	18 in.	100	
¾ in.	75	100	9 in.	65	95
⅜ in.	50	85	6 in.	50	80
No. 4	35	65	3 in.	30	65
No. 10	25	50	¾ in.	10	35
No. 40	15	30	No. 4	0	15
No. 200	5	15			

Surface stones were specified to weigh not less than 1,400 lb each, and the interstices tbeween them were chinked with smaller stones to prevent washing out of the underlying filter. To form a definite crest and prevent direct flow through the filter, a concrete wall 2½ ft high and 2½ ft wide was poured on top of the earth core. Past records indicated that this dam would be overtopped on the average of once a year, and this overtopping has occurred every year since construction in 1955.

During the second year of operation the dam was overflowed to a depth of about 3 ft above the concrete crest, and the flow continued for three days. On the second day it was noted that in one area on the downstream face, the surface stones had slumped 1 to 6 ft below their original position. This damaged area measured about 60 ft in length parallel to the axis of the dam and extended from the crest down the slope 25 ft.

When the flow over the dam had stopped, is was found that practically all the filter stone and as much as 3 ft (in depth) of the earth core had been washed out in this area and that the larger surface stones had dropped more or less vertically. At places along the concrete crest wall within this area, the earth core had been washed out from under the downstream side of the wall to a depth of 8 in., but at no place did the water actually flow under the wall.

The total length of this rock-protected earth dam is 340 ft; while there was some indication of displacement of the stones over most of the downstream face the area described was the only one where there was any definite indication of danger from a continuous flow equal to that experienced. Practically no medium-sized stones were found among those washed out from the damaged area. This probably indicates a deficiency in the gradation of the coarse filter and in the chinking between the surface stones.

The damaged area was repaired by depositing filter material around and over the heavy stones in their settled positions and adding large stones to restore the original outline. Then, since the flow experienced was much less in volume and duration than can be expected in future, the crest and a portion of the downstream slope for the full length of the dam were reinforced by placing concrete, about 18 in. thick, between the large surface stones. The dam has since been overtopped, to a maximum depth of about 3.5 ft above the concrete crest, for a period of three days with no sign of damage.

This experience, we believe, points up the necessity for determining the proper gradation of the rock blanket required for a given flow. The surface stones of this dam appeared to be of sufficient size to resist movement under the flow experienced, but evidently there was not the proper gradation above the fine filter to obtain the interlocking necessary to prevent washing out of material below.

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About the "Manning formula"

To the Editor: The so-called "Manning formula" for the resistance to flow in open channels has come into such general use that its history is a matter of interest. As pointed out by Hunter Rouse, M.ASCE, and Simon Ince, J.M.ASCE, in their excellent *History of Hydraulics*, what we now call the Manning formula was "neither recommended nor even devised in full by Manning himself, whereas his actual recommendation received little further attention."

Ivan E. Houk, M.ASCE, in his *Calculation of Flow in Open Channels* (Part IV of the Technical Reports of the Miami Conservancy District, 1918), under the heading "The Manning Formula," gives the formula Manning recommended as

$$V = C_1 \sqrt{Sg} \left[\sqrt{R} + \frac{0.22}{\sqrt{m}} (R - 0.15\, m) \right]$$

where m is the height of the column of mercury which balances the atmospheric pressure. He says that the first publication of the formula,

$$V = \frac{1.49\, R^{0.67}\, S^{0.50}}{n}$$

seems to have been by Parker in his *Control of Water* in 1915.

Manning had mentioned the formula,

$$V = C_2\, R^{2/3}\, S^{1/2}$$

but considered it unsatisfactory. However, he noted that "the value of the reciprocal of C_2 corresponds closely with that of n." This evidently refers to the use of metric units. Although n is not dimensionless, those who converted Kutter's formula for use with English units changed the constants so as to keep the value of n the same in both systems of units. Parker (or some unknown person whom he is following) did the same for the Manning formula by introducing 1.49 or 1.486, which is the cube root of the number of feet in a meter.

Manning was not the first to suggest that

$$V = C\, R^{2/3}\, S^{1/2}$$

Hagen had published it in 1881 and Gauckler in 1868. Houk seems to have believed that these two collaborated, but that is a misunderstanding. He refers (on page 212) to earlier articles by Hagen going back to 1854, but whether any of these suggested the particular value of the exponents ⅔ and ½ is not clear.

Merriman's *American Civil Engineers' Pocket Book*, published in 1910, makes no mention of the Manning formula, nor does the 10th edition of his *Hydraulics*, published in 1916, nor does Hoyt and Grover's *River Discharge*, published in 1912. If any writer referred to what we now call the Manning formula by that name before 1915, the writer would be glad to know of it.

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University of Kansas

Lawrence, Kans.

SOCIETY NEWS

Fund Raising For Center Makes Progress

In May the well organized National Industry Giving Campaign passed the $3,230,000 mark. Together with member-giving pledges already received and the assets of the Societies available for the United Engineering Center the campaign has reached the half-way point toward its $10,000,000 goal.

A brief summary of the steps taken over the past half-century to establish a center for the engineering profession in the United States—a symbol of service and professional unity—follows.

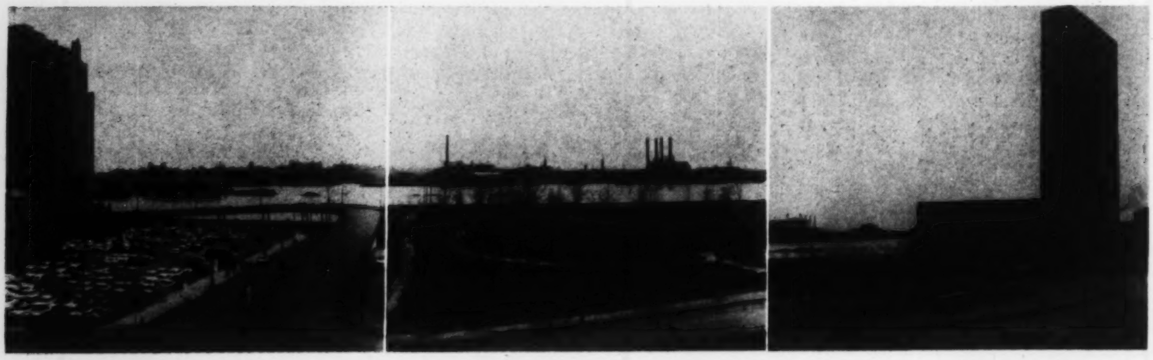
United Engineering Trustees Inc. (UET) was incorporated in 1904 by special act of the New York Legislature to hold common funds of the then three Founder Societies—AIME, ASME, and AIEE. The first major contribution to the profession was the $1,050,000 generously donated by Andrew Carnegie for the erection of a home for the engineering profession in New York City. Constructed on a property at 29-33 West 39th St., which was purchased for just over a half-million dollars with gifts from members and friends of the profession, the Engineering Societies Building was started in 1906. The 13-story building was occupied early in 1907. When in 1916, ASCE became the fourth Founder Society the building was extended upward three more stories, the major cost being borne by ASCE. It is of interest to structural engineers that independent steel columns were extended from new footings up through the existing building to support the top three floors. ASCE combined its library of 89,000 accessions with those of the other societies, and donated the book stacks which had held them at its 57th Street headquarters. The stacks were installed on the new 14th floor, and ASCE Headquarters staff personnel occupied the 15th and 16th floors where they are today.

Although substantial and adequate when the Societies were small, the building is no longer sufficient in size or economical and efficient in operation. It is deteriorating at an alarming rate with maintenance costs mounting to unreasonable figures. The block in which the building is located has become a light manufacturing area for garments and the narrow one-way street is congested with big van trucks during most daylight hours.

Proposals were made at one time to move Society Headquarters to some other city than New York. Suggested sites included Chicago, Philadelphia, Pittsburgh and Washington, D. C. Substantial financial and property inducements accompanied some of the offers. A decision seemed impossible to reach until June of 1955, when 21 engineering, industrial, and educational leaders, headed by Dr. M. J. Kelly, of the Bell Telephone Laboratories, offered to undertake an aggressive campaign to raise the funds for a new United Engineering Center in whatever location an impartial study determined upon. With the help of professional consultants a 15-man task committee, after an exhaustive study, recommended that the Center remain in New York. By late 1956 the recommendation had been approved by the last of the Boards of the Four Founder Societies and AIChE which, as noted on another page of this issue, became the fifth Founder Society on May 1 of this year. UET was given the responsibility for the plans for the building, and then for constructing, owning, and operating it. Architectural studies of the old building convinced UET of the impracticability of using the present site, and during the summer of 1957 the property fronting on United Nations Plaza between 47th and 48th was purchased for $2,700,000. Here the home for the engineering profession in the United States will rise. It is intended for the whole profession—not for the Five Founder Societies alone.

Estimates have placed the cost of the Center—both property and building—at $10,000,000. Proceeds of the sale of the present building plus assets on hand available for real estate purposes are expected to total $2,000,000. The National Industry and the

This view, looking east from about the elevation of the sixth floor of the proposed United Engineering Center, includes United Nations Buildings on right, the UN park, and Long Island City in the background across the East River.



Greater New York Business Campaigns are seeking to raise $5,000,000 from major industrial and commercial firms. To date they have obtained pledges for 60 percent of their goals. The remaining $3,000,000 has been accepted by the Societies which will occupy the building, to be raised from among their membership as voluntary contributions. Quotas have been allocated on a membership basis as follows: AIEE, $900,000; ASCE, $800,000; ASME, $800,000; AIME, $500,000; and AIChE, $300,000. Quotas for the associate societies who will share the building are yet to be established.

Each Society's Member Giving Campaign has been organized separately, but along similar lines, following a technique recommended by expert fund-raising consultants. In ASCE simultaneous campaigns have been organized by the four Vice Presidents to be handled on a person-to-person basis in each Local Section. Not only is the organization completed, but already about $37,000 has been pledged by ASCE members; $200,000 by all the societies.

The time table for the member giving contemplates completion by the end of 1958. Following regular fund raising techniques, the larger gifts will be solicited first, with this phase scheduled for completion on June 30. Next the general and personal solicitation of the membership is slated to begin July 1 and end November 30. Most importantly, during December, every member of the Society will be given an opportunity to join with other engineers throughout the nation in making a modest contribution to a United Engineering Center.

Present Engineering Societies Building is located on congested 39th street. When the Engineering Societies took up residence on 39th street, it was in one of the better and quieter sections of the city. Now it is in a garment manufacturing district.

Phoenix Host to ASCE Executive Committee

The Executive Committee of the Society convened at the Westward Ho Hotel in Phoenix on April 18 during the Pacific Southwest Council Conference. All members were present—President Howson, who was in the chair; Past-Presidents Needles and Lockwood; and Vice Presidents Friel, Morris, Bowman, and Moore. Executive Secretary Wisely was also present. The actions taken are briefed here.

AIChE—the Fifth Founder Society

United Engineering Trustees had previously submitted to ASCE the "Founders' Agreement, Supplementary Agreement, and Library Agreement," for its approval as one of the four Founder Societies of the admission of the American Institute of Chemical Engineers into United Engineering Trustees. The Board of Direction had approved this action in 1956. At its Phoenix meeting the Executive Committee therefore authorized the President and Secretary to execute, on behalf of ASCE, the documents needed to complete the admission of the AIChE into UET. [At a subsequent ceremony held in New York the agreements were signed by the presidents and secretaries of the UET societies. See the separate item elsewhere in this department.]

Critical Tables Board of NSF

Acting on an invitation to ASCE from the National Science Foundation to name a representative to serve on the Advisory Board of the Office of Critical Tables, the Executive Committee named Prof. Jewell M. Garrelts. The Office of Critical Tables coordinates the production and compilation of all critical tables of numerical data, which issue from the engineering and scientific laboratories of the world.

EJC-AIA Joint Committee

In response to a memorandum from Engineers Joint Council asking the Society to name a representative to the new EJC-AIA Joint Committee, the Executive Committee nominated Charles H. Topping. When the new committee is formed, it will replace the ASCE-AIA Joint Cooperative Committee.

ASCE Group Insurance Program Modified

The tenth year of the ASCE Group Disability Plan begins next August. The administrators of the plan reported that the claim experience has been sufficiently satisfactory to warrant additional benefits and liberalization of certain underwriting rules without increasing the cost of the coverage, and proposed certain changes in the plan to accomplish this. After careful consideration the Executive Committee approved the recommendations so that the benefits would be available to policy holders. A brochure including the changes will be mailed by the administrators in July.

ASCE Executive Committee takes time out for a photo during its Phoenix meeting. Seated (in usual order) are ASCE Vice President Waldo Bowman; President Louis R. Howson; and Vice President Samuel Morris. Standing are Vice Presidents Norman Moore and Francis Friel; Past Presidents Mason Lockwood and Enoch R. Needles; and Executive Secretary W. H. Wisely.

EUSEC Meets in New York City

For the first time a conference of representatives of the Engineering Societies of Western Europe and the United States (EUSEC) convened in America. The Sixth Conference of EUSEC was held at the Hotel Roosevelt in New York City, April 28-May 2, with 45 delegates representing 23 engineering societies in 14 countries attending.

Following several years of preliminary ground work, the three British Engineering Institutions in 1948 invited the presidents and secretaries of the national engineering societies of Europe and the United States to meet together in London to determine ways in which their organizations could cooperate in furthering the purposes of their organization. The meeting in October 1948 was a success, and paved the way to a second meeting, again held in London, in September 1949, at which a constitution and operating procedure were agreed upon. Since then conferences have been held in The Hague (1951), Paris (1953), and Copenhagen (1955).

In a warm welcome to the delegates attending the Sixth Conference, ASCE President Louis R. Howson said: "History has proved that engineering never has known boundaries. Our profession is such that our skills should not and, indeed, cannot be confined to one community, state, or nation. Members of the five American societies, which I represent here, are today working all over the world. The same is true of the societies and councils you represent in European countries. If there were boundaries, we would not be meeting here today. In fact, there would be no EUSEC. I am sure you will find American engineers as enthusiastic and energetic about EUSEC as their visitors from abroad. I welcome you to the United States and to the Sixth General Assembly of EUSEC."

Engineering education and training have been given the most active attention by EUSEC since its inception. Three assemblies have devoted attention to these important subjects. The Proceedings of the Third EUSEC Conference on Engineering Education, held in Paris in September 1957, are in print with special appendixes covering practices in Belgium, the United States, and the United Kingdom. In the Proceedings are reports from, and appraisals of, the methods followed in the participating countries. The subjects covered include: (1) a glossary of terms used in engineering education and training, (2) general education before admission to the university, (3) selection for admission to the engineering school, (4) education in the schools and universities, (5) postgraduate education and training, (6) practical training of the engineer, and (7) criteria for professional recognition.

Other important topics given continuous consideration by EUSEC are: (1) abstracting and classifying engineering literature, (2) defining the terms "professional engineer" and "engineering technician," (3) fostering and facilitating the exchange of lecturers, (4) establishing reciprocal arrangements for extending professional courtesies to society members of one country visiting the country of another society, and (5) reporting on the supply of and demand for engineers, so that they may be utilized to their fullest capacity. All these subjects were on the New York Conference agenda.

At the New York Conference Ove Guldberg, retiring general secretary of EUSEC and secretary of Dansk Ingeniorforening, formally transferred the management responsibilities of EUSEC to the USA societies. William H. Wisely, Executive Secretary of ASCE, was named general secretary, and O. B. Schier, secretary of ASME, became editor of the EUSEC Bulletin. Two engineering societies were admitted to EUSEC: Ordem dos Engenhiros de Portugal and the Instituto de Ingenieros Civiles de Espana, and the delegates from these societies were seated and participated in the deliberations of the Conference.

Participants in the New York Conference of EUSEC included the following:

BELGIUM

Société Royale Belge des Ingénieurs et des Industriels
Edmond Hianné, secretary

DENMARK

Dansk Ingeniorforening
Axel Kristensen, authorized deputy
Ove Guldberg, secretary

FINLAND

Samarbetsdelegationen i Finland
(Joint Committee representing Suomen Teknillinen Seura and Tekniska Foreningen i Finland)
Aulis Junttila, president
R. S. Halonen, secretary

Participants in the highly productive Sixth EUSEC Conference, held in New York City, April 28-May 2, included representatives of 23 engineering societies in 14 countries—a fine example of international cooperation.

FRANCE

Société des Ingénieurs Civils de France
Georges Ville, secretary

GERMANY

Verein Deutscher Ingenieure
Dr. Ing. H. Grünewald, secretary

HOLLAND

Koninklijk Instituut van Ingenieurs
Ir. G. A. Tuyl Schuitemaker, president
Ir. J. Ligthart, secretary

ITALY

Associazione Nacionale Ingegneri ed Architette Italiana
Prof. Ing. Andrea Ferrari-Toniolo, delegate

NORWAY

Den Norske Ingeniorforening
Asbjorn Aass, president
A. Nagell, secretary

PORTUGAL

Ordem dos Engenheiros
Jose Freire d'Andrade, delegate

SPAIN

Instituto de Ingenieros Civiles de Espana
José Vergara Doncel, delegate

SWEDEN

Svenska Teknologförening
John Faerden, president
Oskar Akerman, secretary
Sigvard Strandh, special deputy

SWITZERLAND

Schweizerischer Ingenieur und Architekten Verein
Georg Gruner, president
Pierre Soutter, secretary

UNITED KINGDOM

Institution of Civil Engineers
Sir Arthur Whitaker, president
Alexander McDonald, secretary
Institution of Mechanical Engineers
Sir George Nelson, president
Brian G. Robbins, secretary
Institution of Electrical Engineers
T. E. Goldup, president
W. K. Brasher, secretary

UNITED STATES

American Society of Civil Engineers
Louis R. Howson, president
W. H. Wisely, secretary
American Institute of Mining, Metallurgical and Petroleum Engineers
Dr. A. B. Kinzel, president
Dr. Joseph G. Gillson, authorized deputy
Dr. E. O. Kirkendall, secretary
American Society of Mechanical Engineers
J. N. Landis, president
O. B. Schier, II, secretary
American Institute of Electrical Engineers
W. J. Barrett, president
Robert H. Barclay, authorized deputy
N. S. Hibshman, secretary
J. J. Anderson, assistant secretary
American Institute of Chemical Engineers
George R. Holbrook, president
Stephen J. Tyler, authorized deputy
F. J. Van Antwerpen, secretary
United Engineering Trustees, Inc.
W. J. Barrett, president
Engineers' Council for Professional Development (U.S.A.)
Chairman, Morris D. Hooven (Past President, AIEE)
Chairman of U.S.A. delegation to EUSEC Conference on Education and Training, Dr. Thorndike Saville
Engineers Joint Council (U.S.A.)
Chairman, Enoch R. Needles (Past President ASCE)
Chairman of Committee on International Relations, Gail Hathaway (Past President ASCE)
Secretary of Engineering Manpower Commission and secretary to EUSEC Working Party on Supply and Demand, William T. Cavanaugh

An invitation from the Société Royale Belge des Ingenieurs et des Industriels to hold the next conference in Brussels was accepted for September 1960 or April 1961, with the exact date to be determined by the Advisory Committee. The committee consists of Paul Bastien, chairman, and William H. Wisely, Edmond Hianné, Ove Guldberg, A. Clifford Hartley, and Dr. H. Grunewald.

"Seven Wonders" Plaque Unveiled at Hoover Dam

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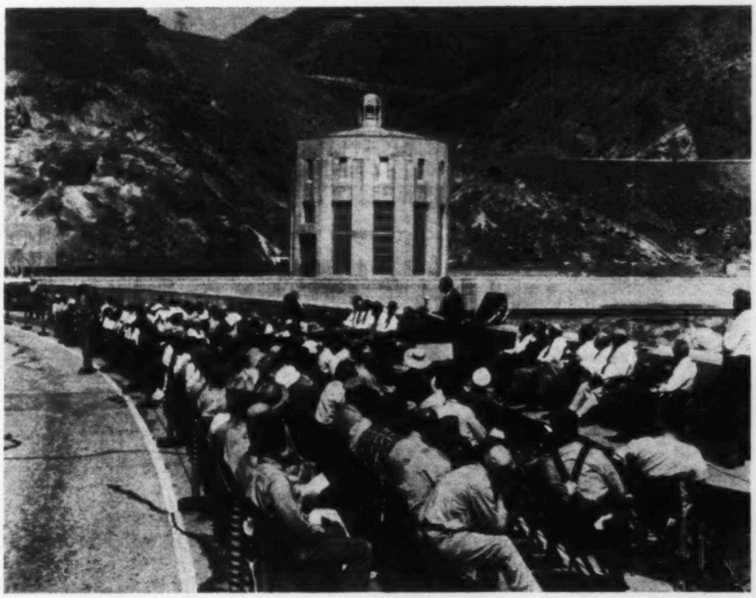
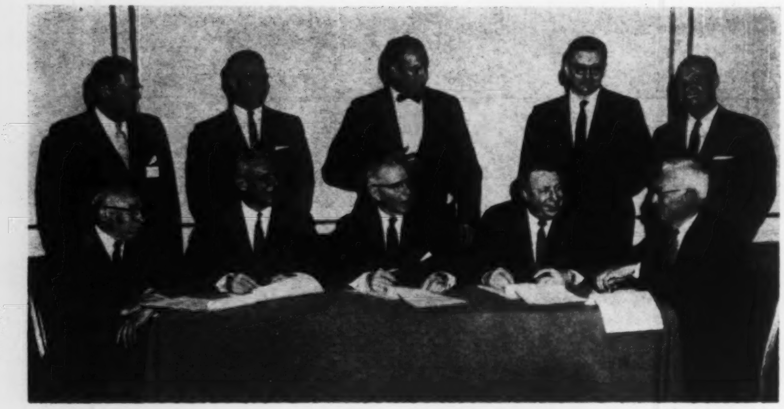
SECTIO

ASCE President Louis R. Howson unveils "Seven Wonders" plaque at Hoover Dam site in ceremony honoring the structure. W. A. Dexheimer (right), Commissioner of Reclamation, accepts the plaque for the Bureau of Reclamation, which constructed Hoover Dam. Looking on is ASCE Vice President Samuel Morris, who was master of ceremonies.



Prominent engineers and representatives of the government are in the large crowd attending unveiling of the bronze plaque commemorating the selection of Hoover Dam as one of the seven modern civil engineering wonders of the United States. The plaque, hailing the structure as "the world's highest dam," is mounted in a concrete pedestal on the upstream parapet wall atop the dam on the Nevada-Arizona boundary. Shown in the speaker's stand is ASCE Vice-President Samuel B. Morris, former chief engineer and general manager of the Los Angeles Department of Water and Power. Mr. Morris was master of ceremonies.

AIChE Becomes Fifth Founder Society



Attending ceremony connected with the signing of Founders' Agreements were (seated, in usual order): David W. R. Morgan, past president of ASME, representing President James N. Landis; Augustus B. Kinzel, president of AIME; Walter J. Barrett, president of AIEE and also of UET; George E. Holbrook, president of AIChE; and Louis R. Howson, president of ASCE. Standing are Secretaries O. B. Schier II, ASME; Ernest O. Kirkendall, AIME; Steven W. Marras, UET; F. J. Van Antwerpen, AIChE; and William H. Wisely, ASCE. AIEE Secretary Nelson Hibshman was unable to be present.

Induction of the American Institute of Chemical Engineers as a Founder Society by United Engineering Trustees, on May 1, marked the first time in forty-two years that a national engineering society has been admitted to membership in the group. Formal approval voted by the American Institute of Electrical Engineers, meeting in Washington, D. C., on April 30, concluded agreement of the Founder Societies. The other signatories were ASCE, which voted approval through the Executive Committee at its recent Phoenix meeting (page 71), the American Society of Mechanical Engineers, and the American Institute of Mining, Metallurgical, and Petroleum Engineers.

The AIChE, which is celebrating its golden jubilee this spring, was founded in Philadelphia in 1908 to advance the theory and practice of chemical engineering. In half a century it has grown from 500 members to over 18,000 members. AIChE will join the other four Founder Societies in establishing its headquarters in the new United Engineering Center.

How Can an ASCE Convention Serve You Best?

This is the question the Society's Committee on Meetings asks and answers in an arresting leaflet prepared to stimulate interest in ASCE meetings and Conventions. Noting that "The old characterization of the convention as a place to get away from routine and 'blow off steam' is as out of date as the coach and four," the leaflet goes on to say that conventions these days "are planned to expand the professional horizons of those who attend, and make the process pleasant."

Unfortunately, the committee finds, "continuous improvement can be charted in most every element of the convention —except in that all-important factor, the conventioneer. Too many engineers who could profit from the opportunities of convention attendance are not attending," it says, "and many who do attend fail to get the most out of their attendance." In the belief that both types should review a few characteristics in which engineers take pride and see how they apply to convention attendance, the Committee on Meetings has given some tips for the intelligent conventioneer. Its suggestions follow:

The Engineer Is Decisive

An engineer makes his bread and butter with his ability to make decisions. Yet when it comes to deciding to attend a convention, procrastination and indecision set in, often without consideration of the factors on which a clear, early decision could be made. Early decisions clear the way for an enjoyable convention attendance.

The Engineer Is a Planner

An engineer takes pride in his ability to plan years ahead, so that the need of some future date can be met. Yet a frequent comment is, "I intended to go, but at the last minute couldn't make arrangements to get away from the office." Planning should proceed from the very day a decision to attend is reached.

The Engineer Is a Traveler

In conduct of their profession, engineers span the globe, and take frequent business trips in stride. Yet when it comes to advance reservation of hotel rooms for a convention, or for air space necessary to meet a certain time schedule, disappointments are in store for the man who arranges his travel late or incompletely. Hotel rooms can be reserved early—and cancelled if plans to attend must be cancelled. The same holds for air or train reservations. Early reservation requests should be specific about the type of facilities desired. A contented traveler is the one who finds needed facilities reserved and awaiting his use.

An Engineer Is a Scholar

Continuing training is essential to professional competence, we are told time and again. The firm base of the ASCE Convention is the strong program which presents new information, with all the enthusiasm of the man who has generated that new knowledge. To make the most of this happy circumstance, it is prudent to study the Convention program in advance, and to schedule time for attendance at events of special interest.

An Engineer Is a Businessman

In the conduct of his profession, the engineer must be businesslike in his isolation of a problem and an attempt to find practical answers. Before attending the Convention, it pays to jot down notes on a few current perplexing problems being faced in your own office. With this preparation, you quite often find the man with the answers when you attend the Convention. Also it is possible to get a quick look at current procedures or methods being used by others in your specialty.

An Engineer Enjoys Wide Acquaintance

Because of the many contacts an engineer must establish, in the line of his professional activities, it is inevitable that he will run into old friends and acquaintances at the Convention, and make a lot of new contacts also. This is one very important aspect of attending, indeed! A proved aid to such pleasant and profitable visits is to drop a note, in advance, to each man you want particularly to see at the Convention, suggesting that you will call him at the Convention, or even setting a specific time for a chat, or "bull session" with several friends. When you arrive at the Convention, check the list of those registered, get in touch with those you want to see. Capitalize on social functions of the Convention. This provides a splendid opportunity to get a group together (and still not be caught with a large entertainment check). Scratch down the names of new acquaintances, and their professional connections. Most people who "just can't remember a name" do not avail themselves of this simple aid.

An Engineer Enjoys Living

Such a businesslike approach does not preclude enjoyment of Convention attendance. It is reported (to make the point) that it was an engineer who first exclaimed, "All work and no play makes Jack a dull boy!"

Participation in Convention social events can be enjoyed most with a little advance planning. Arrange in advance which events you will attend, and with whom. Plan table arrangements, so you can be with the people with whom you want particularly to spend more time. For free evenings, try to take some time from preparing reports and answering urgent correspondence to enjoy some entertainment—with a congenial group. This too takes some planning, and arrangement in advance with those who would make good company.

Some conventions have the problem of overindulgence. The only overindulgence with which ASCE Conventions contend is too much work. It is sad to see a man travel across the country, spend solid hours in meetings and working on reports, then get back on the plane and return home—without even looking out of the hotel, or attending the social events in the hotel. To get the most out of Convention attendance, some recreation should be provided for in advance, even if it takes another day away from the office.

An Engineer Can Get More Value

Take a look at any recent Convention program. See the many opportunities offered to the man who can, and will, plan his own time and participation to make the most of this Convention attendance. Real values await your initiative.

More Research Urged at TPC Conference

ASCE was urged to step up its research activity at a meeting of the Technical Procedure Conference held in Memphis on May 1 and 2. Dr. Arthur T. Ippen, vice-chairman of the Society's Committee on Research and professor of civil engineering and director of the Hydrodynamics Laboratory at the Massachusetts Institute of Technology, reminded the group that, "Fundamental research today is applied research tomorrow, and . . . applied research today is design practice tomorrow.

Dr. Ippen also reported some recommendations for more research his committee has made to the Board of Direction. These recommendations include: (1) more publicity for Society research activity in the Civil Engineering field, (2) research conferences, (3) graduate research fellowships, (4) a research and design digest, and (5) a research department at Society Headquarters. The recommendations were enthusiastically endorsed by some fifty key Society members attending the meeting.

The Technical Procedure Conference provides an annual opportunity for Society officers and the leaders of the fourteen Technical Divisions to get together for an exchange of ideas and information. Although little formal action is taken at these sessions, the TPC acts as a sounding board and has been indirectly responsible for many changes resulting in smoother and more efficient operation of the Divisions and the Society. Some twenty subjects came up for discussion at the two-day meeting. Presiding were ASCE Vice-Presidents Francis S. Friel, Philadelphia consultant, and Samuel B. Morris, consultant to the Los Angeles Department of Water and Power.

In trying to best serve their membership, the Divisions constantly face problems, such as how to attract attention at the various conventions and conferences; planning committee meetings for most effective operation; and planning and conducting Technical Division conferences.

A thirteen-step procedure that has been useful in planning the Structural Division participation in the October Convention was outlined by Leo H. Corning, chairman of the Structural Division's Executive Committee. The eight sessions, which will be co-sponsored by the International Association of Bridge and Structural Engineers, the Engineering Mechanics Division, and the Structural Division, will feature fourteen papers by domestic authors and thirteen by foreign authors. At this point co-sponsorship received a strong vote of confidence by the engineers attending the conference. The elimination of competition, which results in larger audiences, was believed to be one of the greatest single advantages of joint sponsorship. Successful meetings do not just happen, Mr. Corning informed the group; they are the result of strong programs, thorough planning, and advance publicity.

Technical committee chairmen were urged by Harold M. Martin, chairman of the Executive Committee of the Hydraulics Division, to have planning meetings very early in the year. The Division newsletters, Mr. Martin explained, then could be used to inform members of the various planned activities of their Division. It was also emphasized that early planning of this nature simplifies matters involving the budget.

A topic of interest to many members of the Society—Division Conferences—was described as having a three-point value in a discussion, led by Reginald J. Sutherland, secretary of the Executive Committee of the Air Transport Division. In addition to providing a program of concentrated topics, the Technical Division Conferences give the Local Sections a chance for cooperation in the form of joint sponsorship. It is also believed that this type of meeting attracts more Junior Members than do Conventions.

Okie L. Pickering (left), president of Mid-South Section's Memphis Branch, greets Francis S. Friel, Vice-President of ASCE and chairman of Technical Procedure Conference, at TPC meeting in Memphis.

Technical Publications, one of the most valuable services ASCE offers its members, was another of the topics discussed. The reviewing procedure currently being used by the Engineering Mechanics Division for technical papers was reported by Daniel C. Drucker, vice-chairman of the Division's Executive Committee. Other technical journals are receiving papers that could and should be published by ASCE, Professor Drucker noted. The elimination of Transactions and the improvement of Proceedings, which would then become the permanent record of Society publication, was suggested as one possible way of attracting more authors to ASCE. The ASCE Committee on Publications will receive Professor Drucker's suggestions for further study.

The budget, a subject of much interest to all attending the meeting, was introduced by Vice-President Friel who is also the chairman of the Budget Committee. Mr. Friel informed the group that the Society is currently operating on a budget of $1,500,000, of which $125,000 is allocated to the Technical Divisions. He mentioned that additional financial requests are often met during the year, and suggested that the Divisions should consider submitting financial requests as soon as the need for them arises rather than postponing possible improvements in the operation of the Divisions.

While profiting from the Conference, the group had a chance also to enjoy Southern hospitality. The Memphis Branch of the Mid-South Section, under the guidance of its president, O. L. Pickering, arranged a luncheon as well as a delightful evening for the visiting engineers.

ASCE Commends Student Chapter Work

President Howson has announced the annual awards to Student Chapters for superior work during 1957. Fifteen Student Chapters have been awarded Certificates of Commendation, and 55 Chapters have been honored with Letters of Honorable Mention. Chapters winning Certificates for their outstanding work are:

Southern Region
Virginia Military Institute (22nd time)
Alabama Polytechnic Institute
The Citadel

Middle Atlantic Region
Michigan State University
Ohio Northern University (3rd time)
Carnegie Institute of Technology (16th time)

Western Region
California Institute of Technology (7th time)
University of Utah (3rd time)
State College of Washington

Northeastern Region
Cooper Union (7th time)
Northeastern University (12th time)
University of Vermont

North Central
University of Notre Dame (4th time)
South Dakota State College (9th time)
Missouri School of Mines and Metallurgy (5th time)

Letters of Honorable Mention commending Student Chapters for their excellent work go to the following schools:

Southern Region
Texas A & M
Texas Technological College
University of Florida
Texas Western College
University of Virginia
Virginia Polytechnic Institute
North Carolina State College
Mississippi State College
Duke University
Louisiana State University
Georgia Institute of Technology
Howard University

Middle Atlantic Region
University of Cincinnati
Drexel Institute of Technology
Bucknell University
University of Michigan
Johns Hopkins University
University of Detroit
University of Delaware
Pennsylvania State University
University of Akron
University of Maryland

North Central Region
Kansas State College
University of Louisville
University of Nebraska
University of Wisconsin
Oklahoma State University
Marquette University
Washington University
University of Illinois
Iowa State College
University of Missouri
University of Kentucky
Illinois Institute of Technology

Northeastern Region
University of New Hampshire
University of Maine
Newark College of Engineering
Massachusetts Institute of Technology
Norwich University
Syracuse University
Rutgers University
Tufts University

Western Region
University of Arizona
University of Colorado
Oregon State College
University of Washington
University of California
University of Denver
University of Idaho
University of Southern California
Stanford University
Utah State University
University of Nevada
South Dakota School of Mines & Technology
Montana State College

Three Certificates are authorized for award by the President in each of the five geographical regions into which the 134 Chapters, two evening divisions, and four branch Chapters are divided for administrative purposes. The Committee on Student Chapters has devised a formula which is used to determine the number of Letters of Honorable Mention. This formula is applied systematically but independently in each region.

Enthusiasm in Chapter programs and increased understanding of the purpose of the Chapters are evident in the keen competition for these annual awards. Active participation in Chapter work leads to equally lively participation in Local Section activities after graduation Congratulations to the Chapter members responsible for the 1957 awards.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.11
Baltimore	1.11	1.11
Boston	1.13	1.13
Chicago	1.30	1.26
Denver	1.19	1.19
Houston	1.12	1.08
Kansas City	1.14	1.14
Los Angeles	1.16	1.16
New York	1.20	1.17
Pittsburgh	0.93	0.93
Portland (Ore.)	1.15	1.15
San Francisco	1.17	1.18
Seattle	1.06	1.07

Highway Departments

Region	Current	Last Quarter
I, New England	0.85	0.88
II, Mid. Atlantic	1.17	1.15
III, Mid. West	1.15	1.24
IV, South	1.07	1.02
V, West	0.97	0.96
VI, Far West	1.15	1.15

Figures are based on salaries in effect as of Nov. 15, 1957. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

Dean Weidner's Convention Address Available

A provocative address given at the Chicago Convention, entitled "An Amateur's Viewpoint on Sputniks-Flopniks—and the Future of the United States," by C. Ken Weidner, M. ASCE, dean of the engineering faculty at the American University of Beirut, Beirut, Lebanon, attracted unusual comment. The address had been delivered a few days prior to the Convention at the Industry Military Conference. A limited number of Dean Weidner's manuscript has been obtained, and as a service to members single copies will be sent without charge if request is made to the Executive Secretary.

Dean Weidner has a long background of experience in naval, railroad, airplane, and atomic construction in the United States, plus service in the Navy during World War II. His residence and work at the American University of Beirut for the past seven years have given him a unique opportunity to look at America through the eyes of a "foreigner." His address is directed to answering the question, "How do we survive as a nation which believes in . . . democracy and Christianity?"

ASCE Manual on Sanitary Landfill

A committee of the Sanitary Engineering Division, under the chairmanship of Desso T. Mitchell, of Columbus, Ohio, has been working for several years on the preparation of a Manual of Engineering Practice on Sanitary Landfill. Before the Manual is published in its final form the Board of Direction will appreciate having the critical comment of competent authorities for the attention of the Manual committee. A very limited number of copies of the complete Manual are available for review. The copies may be kept for two weeks. Comments must be mailed to Society headquarters before July 15.

ASCE Membership as of May 9, 1958

Members	9,947
Associate Members	13,676
Junior Members	17,221
Affiliates	76
Honorary Members	44
Total	40,964
(May 9, 1957	39,712)

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Another Editorial Award For "Civil Engineering"

"Civil Engineering" is the pleased recipient of the 1957 Award of Merit in the twentieth annual editorial competition conducted by "Industrial Marketing." The award, given in the class of "Institutional and Professional Publications," is made for the "best series of articles." Honored is "The Engineer Through the Ages," Prof. James K. Finch's exciting series of thirteen articles, published between February 1957 and March 1958.

Division Doings

Hydraulics Conference at Atlanta

The Hydraulics Division's seventh annual conference—set for Atlanta, Ga., August 20-22—should be on the calendar of every engineer interested in hydrology, fluid mechanics, or applied mechanics. The three full days of technical sessions will feature a wide variety of papers by some of the country's outstanding experts. The complete program, together with necessary registration forms, is scheduled for the July issue. Later a special brochure will be mailed to all Division members.

One of the South's finest hotels, the Atlanta Biltmore, has been selected as the conference headquarters. Conveniently close to the Georgia Tech auditorium, which will be used for the technical sessions, the Biltmore is the logical focal point for the informal social life that traditionally characterizes such conferences. By arrangement with the conference committee, a block of air-conditioned rooms will be offered at special rates: $7.00 single and $10 double (family plan). For those who include the conference in their family vacation plans, it will be good news that the "family plan" includes wives and all children under 21. There will be free parking for delegates on the hotel grounds. For those wishing other accommodations there are many other fine hotels and motels convenient to conference headquarters. A list of these alternative accommodations is available.

The Georgia Tech Architecture Auditorium, where the technical sessions will be held, is air conditioned, acoustically excellent, and in every way ideal for conference use. Within easy reach of the auditorium are some of the Institute's newest and finest facilities, including beautiful Price Gilbert Library, the Rich Electronic Computer Center, and the State Engineering Experiment Station. A conducted tour of the Hydraulics Laboratory is one of the scheduled program features.

The only scheduled meal function for members and guests will be a banquet in the Biltmore's Georgian Room on August 21. The banquet will be preceded by a cocktail hour through the courtesy of friends of the Georgia Section—joint host with Georgia Tech to the conference. The after-dinner program will be nontechnical and guaranteed to appeal to all.

Needless to say, the ladies have not been forgotten in making conference plans. They will be taken on tours and to teas, and given a chance to shop in some of Atlanta's excellent stores. On the agenda for the children are picnics and games and supervised fun of all kinds.

Atlanta offers the visitor a unique combination of the historical past and the dynamic present. Ringed by lakes—among them the great reservoirs formed by Allatoona and Buford dams—it is in the center of a scenic, recreational area. Not too far away are cool retreats in the Great Smokies and Blue Ridge Mountains. Incidentally, those who are afraid that Atlanta in the summer may be on the hot side should remember that it is the highest large city east of Denver, and that summer temperatures there are actually lower than in many of our cities.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

The benefits of travel were shared with the **Central Illinois Section** by C. W. Klassen, speaker at the Section's April dinner meeting. Mr. Klassen, chief sanitary engineer with the Illinois Department of Health and technical secretary of the Sanitary Water Board, based his talk on his recent work as consultant to the Japanese government, the Chinese Nationalist government on Formosa, and the British Colonial Service in North Borneo. Mr. Klassen's trip was in connection with water supply and sewage problems, and he illustrated his lecture with slides showing some of the areas in which he worked.

The younger generation of engineers was honored at the **Cincinnati Section's** April meeting. James H. Hatton, Jr., and John T. Gaunt, civil engineering seniors at the University of Cincinnati, received the Section's annual awards in recognition of outstanding work. Alfred Bowald, the winner of the Daniel V. Terrell Award preliminary competition, was chosen to represent the Section in the finals with his paper, "Should ASCE Membership Grades Be Modified?" New Section officers, elected at the meeting, are: W. G. Hamlin, president; A. C. Andrews, vice-president; Erwin R. Bretscher, secretary; and Jack L. Witherow, treasurer. A. H. Hunter, chief of soils and foundations for A. M. Kinney, Inc., gave an interesting talk on his road construction experience in Central America.

Southern hospitality was extended to a number of out-of-town guests at the **Georgia Section's** April meeting. The visitors included Francis Friel, ASCE Vice-President, Zone II; John Voorhees, chairman of the Committee on Local Sections; Don Mattern, ASCE Director for District 10; and members of eight other Sections. Mr. Friel was the speaker, and he discussed three important Society activities: unity, classification of membership, and the new United Engineering Center. Keeping current with satellite developments, the **Savannah Branch** recently heard a talk by Capt. Warren L. Hurst, officer in charge of Fort Stewart's Project Vanguard Station. Captain Hurst outlined his part in the satellite program which is being conducted in connection with the International Geophysical Year.

The **Hawaii Section's** March meeting was devoted to both local and international affairs. Providing the international flavor were ten irrigation engineers from Japan, visiting Hawaii and the mainland to observe reclamation projects under the International Cooperation Administration program. Closer to home, Frank Lombardi, territorial planning director, spoke on the role of "The Engineer in Territorial Planning." This talk was especially pertinent as a Territorial Planning Office was established at the past session of the legislature.

Full and interesting agenda marked recent **Illinois Section** weekly luncheon meetings. A report and summary of results were given by Bertold Weinberg on the Section's survey, "Career Satisfactions and Expectations Among Civil Engineers in Illinois." George Uitti presented a fascinating and vividly illustrated lecture on "Earthquake Damage in Mexico City." Mr. Uitti dealt with the 1957 earthquake which he had observed. For another program, John O. Miller, of the American Steel and Wire Company, spoke on "The Protection of Highways—Guard Rails," discussing the effectiveness of various types of guard rails.

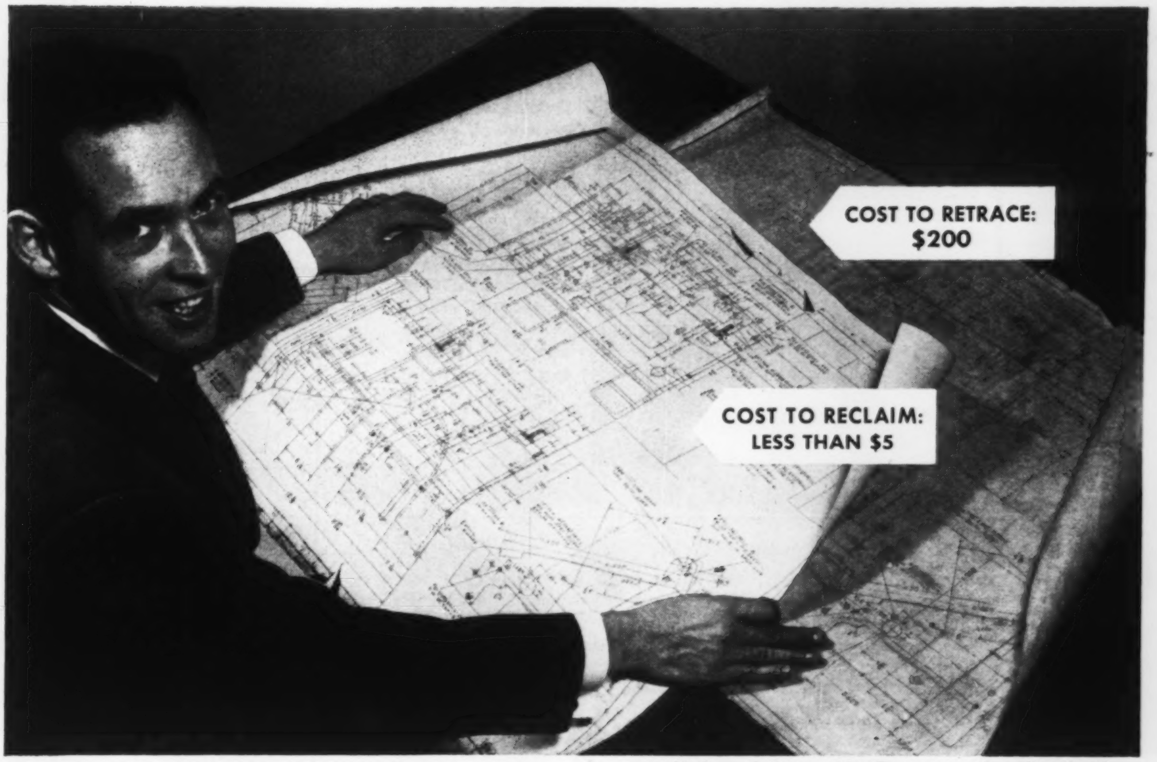
At the March meeting of the **Intermountain Section,** Robert Huefner, of the University of Utah, and Lew Wangsgard, of Utah State University, were announced winners of the Section's student paper contest. Mr. Huefner's paper dealt with "Preliminary Traffic Assignment," and Mr. Wangsgard's discussed "Relative Factors of Crushed and Rounded Aggregate in Concrete." Each winner received $50 to attend the Pacific Southwest Council Conference in Phoenix, Ariz. The featured speaker was A. F. Lorton, director of public relations for the Pacific Northwest Pipeline Corporation. Mr. Lorton spoke on the construction of the pipeline from the Four Corners area to the Pacific Northwest.

A tour of the Forbes Air Force Base at Topeka, Kans., highlighted the April 14 meeting of the **Kansas Section.** On the tour, members observed the full length of the flight line. At the meeting after the tour, Col. Edward Scheele gave an illustrated lecture on the mission of the Strategic Air Command and explained how the Forbes base assisted in fulfilling that mission. Of interest to all was the film, "More Precious than Gold," presented at the April 21 meeting. The film depicted the manufacture of steel products from raw material to finished product.

At a joint April meeting of the **Lehigh Valley Section** and the Lehigh University Student Chapter, members heard Executive Secretary William H. Wisely. In a discussion of "Engineering Unity," Mr. Wisely mentioned some of the problems encountered by the Engineers Joint Council.

Joining forces with the Maine Association of Engineers, **Maine Section** members recently toured the "Sage" project, a radar installation covering the Bangor area of the Air Defense Command in Topsham. The tour included the power house, electronic computer section, and communications section of the installa-

Practical knowledge of testing machinery is gained by members of Akron Section on inspection trip to Macomber, Inc., in Canton, Ohio. Under test here by resident inspectors of Pittsburgh Testing Laboratories is a 32-ft Macomber V-beam; failure occurred at 2.47 times the published load capacity for this unit. Gauges beneath bottom chords showed deflection well within allowable limits. April 3 meeting included a tour of Macomber's Fairhope and Carnahan Plants in Canton, and a dinner and program.



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Outstanding civil engineering seniors receive St. Louis Section annual awards. Erwin E. Bloss (left), vice-president of Section, presents Certificates of Awards to C. P. Ringenberg, Rolla School of Mines, and M. W. Lammering, Washington University.

tion. Col. H. C. Nelson, commanding officer of the "Sage" project, briefed the group on the installation. A movie of the transmountain pipeline extending from Edmonton, Alberta, to Vancouver, British Columbia, was shown.

Members of the **Maryland Section** gained new insight into the government's role in planning for the future at their April meeting. M. E. Scheidt, director of the Baltimore Regional Planning Council, spoke on "The Changing Face of America." In his talk, Mr. Scheidt, concentrated on plans for Baltimore and its metropolitan area—the subject of much study and discussion in the past few years.

The Junior Member Forum of the **Metropolitan Section** met on May 7 to choose new officers for 1958-1959. They are: Harry P. Rode, president; J. M. De Salvo, first vice-president; Howard Grill, second vice-president; Robert Perry, secretary; and Harry Morgan, treasurer. A feature of the meeting was the showing of Western Electric's color film on the construction of the Distant Early Warning Line. Introducing the film was Stanley Rosanoff, supervising engineer with Seelye Stevenson Value and Knecht. Mr. Rosanoff, who has worked on the DEW project, described his experiences in the Arctic.

Miami Section members were treated to an informative evening of papers and speeches at their April meeting. University of Miami students presented three papers in the Section's annual prize-paper competition. Gerald Cravetz won the $25 award for his paper on "Artificial Nourishment as a Means to Control Beach Erosion." The principal speaker, Don Mattern, ASCE Director, discussed national unity among engineers.

Interesting facts on the Trinity River development were explained to members of the **Mid-South Section's Memphis Branch** at the regular April meeting. George E. Tomlinson, assistant chief of the Division of Project Development of the Bureau of Reclamation, spoke on "Trinity River Water Put to Use." The Trinity River Project—part of the Central Valley Project of California—was authorized in 1955. It will cost $260,000,000 and include a 537-ft-high earthfill dam, the highest in the world.

As guests of Fort Belvoir, Va., members of the **National Capital Section** had a recent opportunity to tour the base. Army personnel explained the installations, which included the Redstone Missile Site, the Nike and carbon dioxide generating sites, the Infra-Red Nite Vision section of the Engineering School, and the Army Atomic Package Power Reactor.

The Nebraska Section has elected its new officers for the coming year. They are: Kenneth B. Lucas, president; Nathaniel W. Beezley, senior vice-president; Lawrence E. Miller, junior vice-president; and Paul R. Nyquist, secretary-treasurer. Taking over editorial responsibilities for the Section's publications is James D. Kissell.

Traveling via movie to Lake Pontchartrain, members of the **Philadelphia Section** saw a sound-film at their April meeting, showing the construction of the Lake Pontchartrain Causeway. Charles B. Kiessel, Jr., manager of the prestressed concrete division of the Raymond Concrete Pile Company (now a division of Raymond International), complemented the film with a discussion of the many unique facets of the project.

The Sacramento Section, one of the most active groups in the Society, has added another first to its accomplishments—institution of a "Future Engineers' Day." The program for the occasion, written on the theme—"What Does an Engineer Do?"—was aimed at potential engineers, now of junior high school age, to interest them in becoming the engineers of tomorrow. The program, well attended and well enjoyed, was held at one of the Section's stimulating weekly luncheon meetings.

Panama Section engineers entertained three distinguished visitors at their March meeting. Hosts and guests (shown left to right) are: Col. H. M. Arnold, Lieutenant Governor of the Canal Zone; S. C. Hollister, dean of School of Engineering, Cornell University; R. J. Risberg, Section president; Francis Friel, ASCE Vice-President and Philadelphia consultant; and E. S. Randolph, industrial engineer of Baton Rouge, La.

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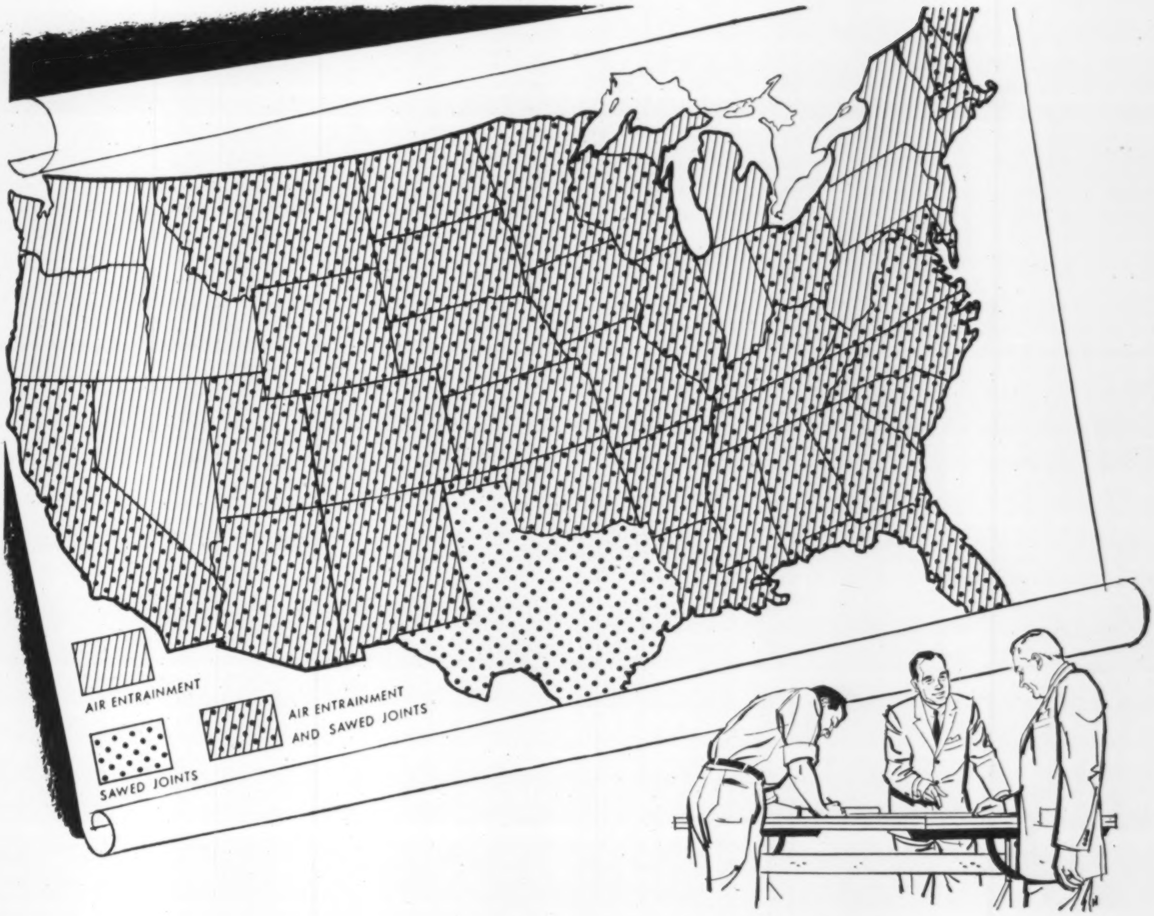

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PORTLAND CEMENT ASSOCIATION

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With the Student Chapter at Washington University as host, **St. Louis Section** members were treated, on April 16, to a varied and interesting program, dealing mainly with engineering education. Student Chapter President J. P. Hartman presented the first talk, "The Changing Civil Engineering Curriculum at Washington University," emphasizing the need for a five-year course. Milton Lammering discussed the ethical and unethical approaches of business recruiters and advised engineering students to study job offers carefully with thought to the future. In a talk on Washington University's research and graduate programs, Fred Reiff used the example of stream pollution, on which the university has worked. The final talk on "The Design and Construction of a Plywood Bent," was given by Henry Edinger and Don Kiselewski, who showed illustrative slides.

At its March meeting, the newly formed **Redwood Empire Branch** of the **San Francisco Section** heard John Rinne, ASCE Director, discuss the relationship between the local and national organization. Mr. Rinne described some activities which will benefit members through the new **Branch.**

The Seattle Section was brought up to date on Student Chapter activities at its annual joint meeting with the Student Chapter from the University of Washington. Two papers were read by seniors at the university, and Bill Pye's paper on "A Rapid Transit Monorail" was awarded first prize. Mr. Pye represented the university at the Northwest Conference of Student Chapters. Fred J. Matthies' entry in the Daniel Mead prize paper competition, "What Procedures Can be Used in Negotiating for Engineering Services to Eliminate Competition on a Price Basis?" was read to the members.

The advisability of forming a local technical group for **Spokane Section** members interested in hydraulics and irrigation was tested at a recent meeting arranged by John Mangan. Engineers representing government and municipal offices in the areas were present to hear C. E. Withers, mechanical engineer in the Penstock Division of the Bureau of Reclamation, speak on water-hammer problems in penstock and pump-discharge lines. However, it was decided to hold such meetings when practical, rather than to schedule a set series.

The Branches of the **Tennessee Valley Section** continued active in March. Members of the **Knoxville Branch** heard Nathan W. Dougherty moderate a panel on "Ethics and Professional Registration." Panel members were Harry Wiersema, assistant to the chief engineer of the TVA; Thomas Rentenbach, of the Rentenbach Engineering Company; and Armour Granger, dean of the College of Engineering at the University of Tennessee. At the **Oak Ridge Branch meeting,** E. A. Whitehurst, director of highway research for the Tennessee Highway Department, spoke on the Interstate Highway Program, with emphasis on the purpose of the program in Tennessee. ASCE Director Don Mattern reported on the ASCE Chicago Convention to the **Chattanooga Branch.** At this session members also heard C. E. Shotwell, Applied Science representative for the IBM Corporation, present an "Introduction to Electronic Computers."

The Fort Worth Branch of the **Texas Section** honored twelve of its past-presidents at a special meeting in April. On hand to receive the accolade of their fellow members were: T. E. Bliss, D. L. Lewis, M. C. Nichols, C. J. Harkrider, Uel Stephens (now president of the Texas Section), J. R. Hendrick, J. J. Burgess, J. K. Alewine, H. H. Hester, J. M. Mapes, A. B. Bell, and Ralph Hardy.

At their April meeting, members of the **Toledo Section** heard a panel of experts discuss the Toledo-Lucas County Water Survey and Report. The panel consisted of Carlton Finkbeiner, Clair Shaler, Robert O'Rourke, Henry Hauenstein, Kenneth Smith, and Joseph Webber, all with Finkbeiner, Pettis and Strout. The speakers outlined the purpose of the survey, the general procedures, and the conclusions obtained by analyzing the Survey data.

ASCE CONVENTIONS

PORTLAND CONVENTION

Portland, Ore.
Multnomah Hotel
June 23-27, 1958

ANNUAL CONVENTION

New York, N. Y.
Hotel Statler
October 13-17, 1958

LOS ANGELES CONVENTION

Los Angeles, Calif.
Hotel Statler
February 9-13, 1959

TECHNICAL DIVISION MEETINGS

CONFERENCE ON ELECTRONIC COMPUTATION

Kansas City, Mo.
Continental Hotel
November 20-21
Sponsored by
ASCE Structural Division
Kansas City Section

HYDRAULICS CONFERENCE

Atlanta, Ga.
Georgia Institute of Technology
August 20-22
Sponsored by
ASCE Hydraulics Division
ASCE Georgia Section
Georgia Institute of Technology

IRRIGATION AND DRAINAGE CONFERENCE

Memphis, Tenn.
September 25-27
Sponsored by
ASCE Irrigation and Drainage Division

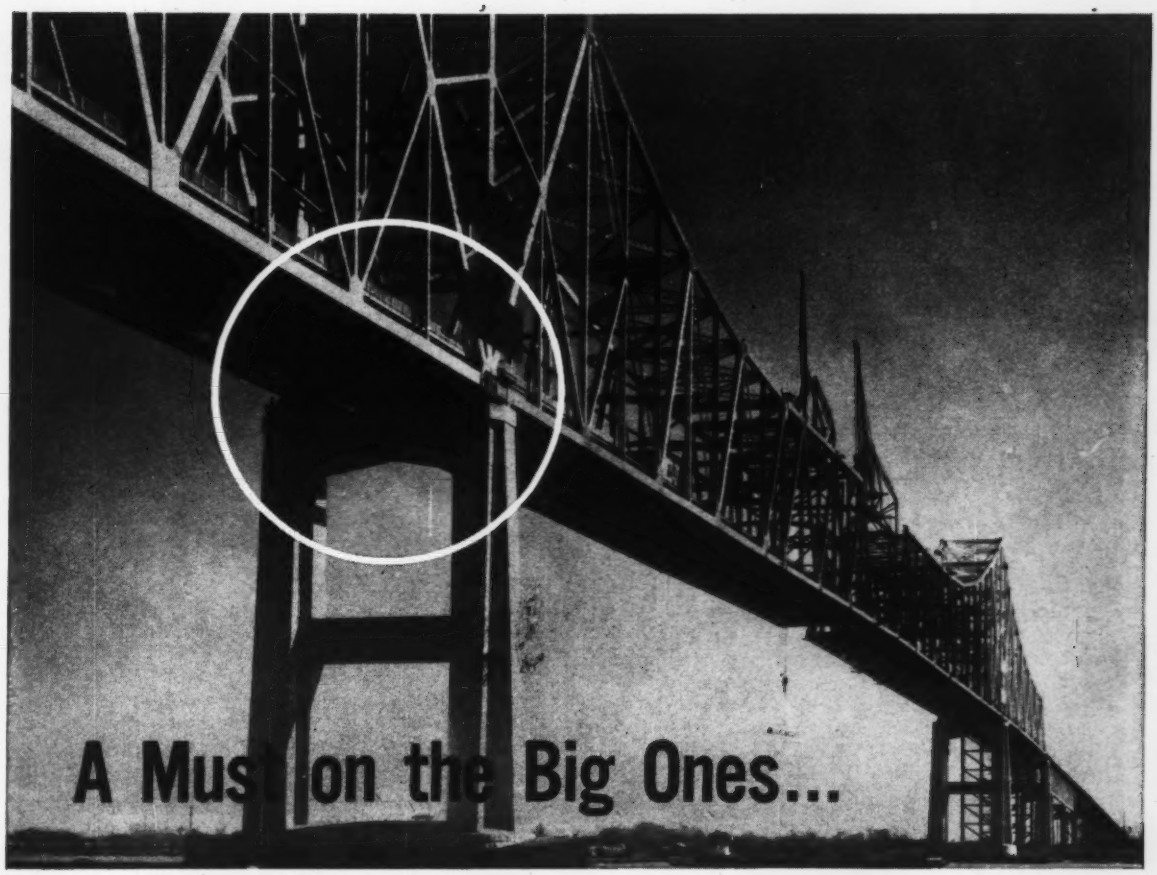
LOCAL SECTION MEETINGS

Dayton—Luncheon meeting at the Engineers Club, June 16, at 12 noon.

Los Angeles—Annual field day at the Candlewood Country Club, June 13, at 10:30 a.m.; San Bernardino-Riverside Counties Branch dinner meeting at Mike's Grill, June 17, at 6:30 p.m.

Texas—Dinner meeting of the Austin Branch at the Engineers and Associates Club, June 19, at 6:30 p.m.; dinner meeting of the San Antonio Branch at the Old Town Inn, June 9, at 5:45 p.m.

Virginia—Norfolk Branch meeting the third Monday of every month at 12 noon in the YWCA Cafeteria; Richmond Branch meeting the first Monday of every month at 12:15 p.m. in the Hot Shoppe Cafeteria; Roanoke Branch meeting the second Wednesday of every month at 6:30 p.m. in the S & W Cafeteria.



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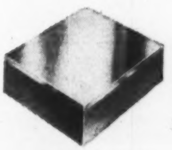

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BY-LINE WASHINGTON . . . . .

The Congressional drive to pass a number of public works construction programs as anti-recession measures slowed down noticeably last month. Maurice Stans, Director of the Budget, came out forthrightly against this strategy to beat the recession. "Such programs, apart from their merits or faults, are not the answer," he said. "I repeat—large public works programs are not the right answer for the country now." The U. S. Chamber of Commerce joined him, particularly in condemnation of the multi-billion-dollar community facilities bill.

The President expressed his views in a veto of the $2-billion Rivers and Harbors Bill, which passed Congress a few weeks ago. His major objection was the same as advanced when he cancelled the 1956 bill—namely, that some of projects included had not been adequately reviewed.

The Administration turned thumbs down, also, on an extension of the Federal-Aid Airport Act, which puts up 50 cents for every 50 cents raised locally to build or improve an airport. (On the other hand, the Administration recently approved federal grants for work at 341 airports in the United States under the existing program. This allocation, amounting to $63 million for fiscal 1959, was the largest made thus far.)

* * *

All the big construction programs born of, or nourished by, the recession scare are by no means dead. The Senate has voiced a resolution calling for a 40 percent increase in Bureau of Reclamation spending, for example. The Administration's budget is for $232 million worth of construction in fiscal 1959; the senators want $330 million, and at least 20 starts on new projects in the Western states. In reply to a request by the Senate Subcommittee on Irrigation and Reclamation, the Bureau reported that eleven major projects are ready for construction and could become the basis for an accelerated program. Together they total $477 million in value.

(An investigation of the Bureau of Reclamation's current program indicates that $4 billion worth of work is now under way, and authorizations were granted previously for $1.2 billion more. In recent years, however, the reclamation program has not received anywhere near the appropriations needed to put that much new work under construction.)

Legislation has been written to boost the annual federal-aid authorization for airport development from $63 million per year to $100 million and to create a special anti-recession fund of $75 million for fiscal 1959. A National Airport Survey made for the four years, 1958-1962, finds that well over $1 billion worth of improvements are needed on the nation's public airport facilities. State and local governments would put up approximately $590 million, leaving $477 million for Uncle Sam to provide.

A bill to multiply federal aid for water pollution control construction, from $50 million a year to $100 million, has been introduced by Congressman John Blatnik. He would also increase the maximum grant from $250,000 to $500,000, and would permit several communities in an area to band together to seek federal aid for a joint project. This latter provision would be most helpful in metropolitan areas, the Congressman claims.

* * *

Professional employees will still be exempt under the federal wage-hour law if they are being paid at least $95 a week. The Department of Labor has revised its minimum salary requirements which define what employees shall come under the federal legislation. Engineers were previously exempt if their salary was above $75 a week.

The National Society of Professional Engineers has asked that exemption of engineers be granted on the basis of registration regardless of salary level, but the federal agency feels that "engineers . . . unlike members of the medical and legal professions, may perform work in their fields without possessing licenses. Thus the exemption would be extended to only a portion of those engaged in these professions. Many engineers . . . who do not possess licenses or certificates qualify for an exemption on the basis of their duties and salaries." To provide an exemption on the basis of license would therefore be unfair, the department claimed, whereas salary is "a good indicator of the degree of importance attached to a particular employee's job."

* * *

One of the boldest engineering schemes ever envisioned was revealed here last month by a Federal Civil Defense Administration official. He unveiled a vast plan to excavate huge deep rock tunnels under America's major cities, large enough to contain entire populations for many weeks. The Congressional committee was shocked at the idea, which FCDA officials insisted was exploratory only. The plan for New York City was particularly imaginative with tunnels connecting the various boroughs so that life might continue routinely under the ground in case of atomic attack.

* * *

The Civil Service Commission wants permission to reimburse new engineers for their household moving expenses to the job. CSC claims that more than 50 percent of those who have declined federal appointments said one of their reasons was the government's unwillingness to pay their moving expenses. The majority of private firms seeking engineers offer to absorb this cost.

* * *

Another film designed to stimulate interest in engineering careers has been released by the American Road Builders Association. The 15-minute, sound, color movie, made in Hollywood, has been produced for showings to high school and college students who may be potential highway engineers. Interested parties may contact ARBA (600 World Center Bldg., Washington 6, D. C.) for information on obtaining the film for group showings.

* * *

The demand for engineers continues to drop, the U. S. Bureau of Employment Security reports. The agency lists 3,000 openings currently, compared with 6,278 at this time last year.

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NEWS BRIEFS . . .

Large-Scale Water-Works Construction Urged by AWWA at Its Annual Convention

A massive water-works construction drive was launched at the 78th annual convention of the American Water Works Association, held in Dallas, Tex., the week beginning April 20. The association wired President Eisenhower that it had just set in motion, "Operation Bootstrap," an all-out drive to help lick the business recession, without federal or state aid, through water-works construction at local level. Fred Merryfield, M. ASCE, retiring president of the AWWA, called for the immediate spending of $750,000,000 a year to clear "the deplorable log-jam of long-shelved water-works projects in communities from coast to coast."

President Merryfield, who is also professor of sanitary engineering at Oregon State College as well as a practicing engineer, told the opening session of the convention that such spending is the only practical way to fill the critical and ever-growing needs of these communities. It can be accomplished without federal or state aid, he contended. President Merryfield's call to action was based on a recently completed personal two-year study of water-works facilities throughout the nation.

He said the water-works industry must create, at the individual community level, the public understanding and support necessary to overcome the "public indifference that has caused some projects to be delayed by several years." Only with this support, he noted, can the American water-works industry begin spending the $750,000,000 a year needed just to keep our systems up to present standards, "which are not high enough." He made it clear that much more must be spent to make and keep our water systems adequate for growing needs. To accomplish the proposed program the AWWA believes that a 25 to 50 percent increase in water rates may be necessary in many cases.

In line with the thought of making the public more conscious of the need for water-works construction was a paper by Burton S. Grant, A.M. ASCE, assistant general manager of the Los Angeles Department of Water and Power. Mr. Grant's theme was that good public relations are never more essential than when streets must be torn up to install water facilities. "With good planning and execution of simple but logical measures," he said, it is possible to obtain acceptance of the temporary inconvenience with good public reaction toward the utility.

One group of papers reported on several large watershed development programs, including Southern California's Colorado River Aqueduct Project, the Arkansas-White-Red Basins development, and the development program in the Sabine River Valley of Texas and Louisiana. New legislation and new procedures needed to ensure an adequate supply of water in the Province of Ontario were outlined by A. E. Berry, general manager and chief engineer of the Ontario Water Resources Commission. Problems of water supply have been extremely acute in the province.

The value of cathodic protection in avoiding underground pipeline corrosion was the subject of a paper by George B. McComb, St. Louis consultant. This paper was one of a group prepared from the vantage point of operators and maintenance men rather than the engineer specialist. Administrative problems were also the subject of much discussion, with the joint administration of water and sewerage facilities hotly debated. Philadelphia Water Commissioner Samuel S. Baxter, M. ASCE, maintained the advantage of his city's administration of its water and sewerage divisions as equals in an integrated department. Spokesmen for a number of other cities endorsed the Philadelphia practice.

One of the significant convention papers was a lengthy and complete report on the reuse of sewage-plant effluent for the emergency water supply of Chanute, Kans.—the joint work of nine engineers from the Kansas State Board of Health and the U. S. Public Health Service. Copies may be obtained from the AWWA.

During the meeting the AWWA board accepted a compromise procedure for manufacturer certification of products sold to the water-works industry. After two-year debate of the subject, it was settled that manufacturers must certify that their products meet applicable AWWA standards. There will be a registered AWWA certification mark for such products. ASCE President Louis R. Howson outlined the approved procedure to the convention, pointing out that the voluntary compliance of producers will be necessary to make the method work. He emphasized, however, that the procedure will be enforced if voluntary compliance is not effective.

At the conclusion of the convention Lewis S. Finch, M. ASCE, chief engineer of the Indianapolis (Ind.) Water Company, was inducted as new president of the AWWA. Lauren W. Grayson, M. ASCE, chief engineer and general manager of the Glendale (Calif.) Water Department, is incoming vice-president, and William J. Orchard, director of the Wallace & Tiernan Corporation, was reelected treasurer.

There was a turnout of over 3,000 for the convention—one of the best attended in the history of the organization.

Get-together at AWWA annual banquet during convention shows (left to right) Prof. Fred Merryfield, retiring president; Lewis S. Finch, the incoming president; William J. Orchard, who was reelected treasurer; and Lauren W. Grayson, incoming vice president.

[*The editors are indebted to Roswell L. Finlay, M. ASCE, with the Dallas consulting firm of Forrest and Cotton, for supplying the material from which this write-up was prepared.*]

Suit May Delay LeTourneau Plans for Manufacturing

A suit filed by the LeTourneau-Westinghouse Company against R. C. LeTourneau, Inc., of Longview, Tex., and its president, Robert G. LeTourneau, may delay the company's plans to resume the manufacture of earthmoving equipment. May 1 had been designated as the day when R. G. LeTourneau, Inc., would officially re-enter the earthmoving equipment industry it left five years ago.

The LeTourneau firm, a pioneer in the manufacture of earthmoving equipment, sold that part of its business to the Westinghouse Air Brake Company in 1953. The $31,000,000 deal contained the provision that LeTourneau would stay out of the manufacture of earthmoving equipment until April 30, 1958. In the interim LeTourneau has been making large special-duty machines, including equipment for jungle clearing, off-shore oil drilling, and heavy logging.

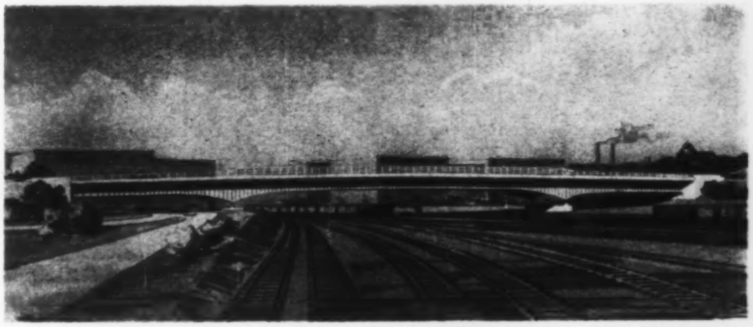
The suit brought by LeTourneau-Westinghouse charges that the contract made at the time of the sale has been violated since Mr. LeTourneau plans to continue as chief executive officer of the LeTourneau Corporation after its re-entry into the earthmoving equipment business. The suit also charges that Mr. LeTourneau has violated the terms of the sales contract by retaining drawings, inventions, and plans. The suit seeks to keep him from serving with R. G. Le Tourneau, Inc., in any capacity for the next two years. It would also prevent his use or sale of any of his inventions or plans developed prior to sale to LeTourneau-Westinghouse and since then to May 1.

Building Costs Continue Slow Annual Rise

Building costs managed to edge up another 2 percent in the twelve-month period ending in March, the F. W. Dodge Corporation reports. This rise came about in the first half of the period. In the second half there was enough price deterioration in retail quotations for materials, equipment, appliances, and accessories to slightly more than offset the impact of higher wages.

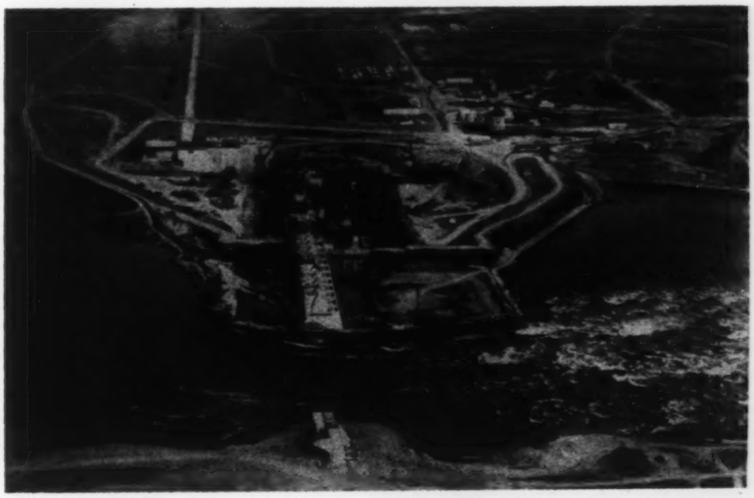
On the basis of information received from several hundred contributors in every part of the country, Myron L. Matthews, manager-editor of the Dow Real Estate Valuation Calculator (an F. W. Dodge Corporation service), foresees the annual rate of rise in costs slowed to 2 or 3 percent. "It appears reasonable to expect," he said, "that the cost of building almost anything from a cottage to a skyscraper will push upward at a rate of about 1 percent every four months." Of the two major components of construction cost—materials and labor—labor exhibits the greater strength.

Connecticut to Have Second Long Plate-Girder Span



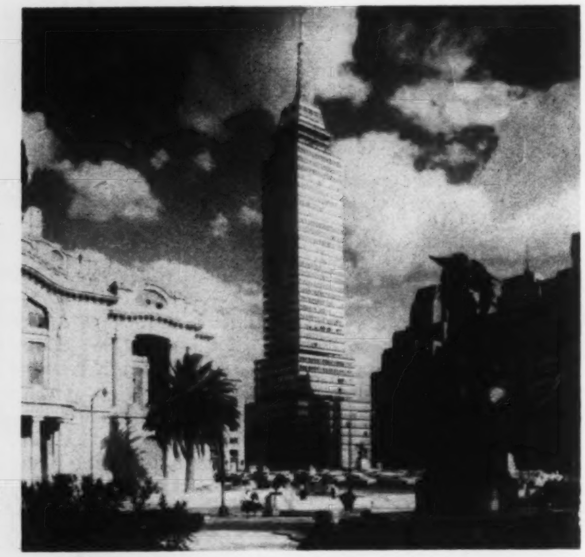
Construction will start this spring on an eight-lane structure (shown in artist's sketch) over the New Haven Railroad's main line and yard near the New Haven Station. Utilizing a 379-ft-long plate-girder center span, with two similar units of 151.5 ft on each side, the structure will carry relocated Route 34, New Haven's principal connection with the Connecticut Turnpike. The center span is the second longest of its type in the Western Hemisphere, being exceeded only by the turnpike's recently completed Quinnipiac River bridge, which has a 387-ft-long plate-girder span. Both bridges were designed by D. B. Steinman, M.ASCE, consulting engineer of New York City. Cost of the new bridge, with approaches and interchange railroad facilities, will be $23,000,000.

Work at Priest Rapids Dam Nears Halfway Mark



With work on Priest Rapids Dam more than 40 percent completed, the low cofferdam dike around the first eleven spillway bays (center of the photo) is being removed so that the Columbia River may flow between the piers, while the remaining eleven spillway bays are constructed on the west side (foreground). As shown at lower left work has started on the cofferdam dike that will divert the river from the area where the last eleven spillway bays are to be built. Inside the high cofferdam is the 1,025-ft-long powerhouse, with fish-passage facilities at upper left. Merritt-Chapman and Scott Corporation is building the dam and powerhouse for the Public Utility District of Grant County (Washington) under a $98,000,000 contract. The Harza Engineering Company, of Chicago, is the consulting engineer. After recent inspection of the project, the five-engineer Board of Consultants for the Public Utility District had words of praise for the way the construction is proceeding.

Earthquake-Proof Mexico City Skyscraper Honored



The 43-story Torre Latino - Americana, the tallest structure ever subjected to seismic shock, is the recipient of the AISC Award of Merit for withstanding the severe earthquake of July 1957.

Mexico City's 43-story steel-frame skyscraper, the Torre Latino-Americana, which emerged undamaged from the record earthquake of last July, is winner of the Award of Merit given annually by the American Institute of Steel Construction. In a ceremony held in Mexico City on April 30, AISC President N. P. Hayes presented a stainless steel plaque to Jose A. Escandon, president of La Latino-Americana, Seguros de Vida, owners of the structure.

The tallest building south of the border and the tallest structure ever exposed to severe seismic shock, the Torre Latino-Americana incorporates the newest techniques of earthquake-resistant design. Though the tower was in the heart of the 2,500-acre area hardest hit, it came through without even a cracked window.

The Award of Merit plaque contains the following inscription: "The Torre Latino-Americana has dramatically demonstrated the wisdom and competence of those who planned its construction. In surviving the effects of the July 28, 1957, earthquake without suffering the slightest damage, it offers mute testimony to the strength and integrity of modern steel construction."

Leonardo Zeevaert and Adolfo Zeevaert, Associate Members ASCE, of Mexico City, and Nathan M. Newmark, M. ASCE, of the University of Illinois, were the designers and engineers. The 3,600-ton steel frame was fabricated by Bethlehem Steel and erected by Julio Jeffrey, Inc., of Mexico City. Concrete piles 100 ft long supporting the building were installed by the Western Foundation Co.

Setting First Steel for New York City Skyscraper

Big job of erecting steel for the new 48-story Time & Life Building gets underway in mid-Manhattan. Nelson Rockefeller (left), chairman of the board, Rockefeller Center, Inc., and Roy E. Larsen, president of Time, Inc., help guide a massive 20-ton grillage into position atop its concrete base in a 40-ft pit that has been excavated along the Avenue of the Americas. The grillage, which will support one of the main columns, will be the first of 28,000 tons of columns and beams. If topping out is completed on schedule by late November, it will break steel-erection records, on both a time and tonnage basis. High tensile bolting, instead of riveting, will speed the work. The $70,000,000 building is scheduled for completion in the fall of 1959. The architects are Harrison & Abramovitz & Harris; the mechanical engineers, Syska & Hennessy, Inc.; and the structural engineers, Edwards & Hjorth. General contractors are the George A. Fuller Co. and John Lowry, Inc. The Bethlehem Steel Co. is the the steel fabricator.

Army Lets Contract for Jackson Lock and Dam

The Army Corps of Engineers has awarded a $14,666,487 contract for the construction of a lock and dam, on the Tombigbee River north of Jackson, Ala., to the Al Johnson Construction Company, of Minneapolis, Minn. The bid was the lowest of nine received and the largest, money-wise, ever awarded by the Corps of Engineers for river and harbor work in the Mobile District. In addition to the lock and dam, the contract covers construction of a control station, water stage recorder houses, roads, and storm drainage facilities.

The new lock and dam will speed shipping on the busy Warrior-Tombigbee Waterway by replacing three small, obsolete locks. The waterway connects the port of Mobile with the industrial region around Birmingham. Work under the newly awarded main contract is expected to get under way in the late spring, with completion scheduled for 1962. The total cost will be about $23,600,000.

ASEE Report Sees Engineer Faculty Costs Tripled

The mounting requirements for engineers in the next decade will not be met unless we are prepared to pay the price of attracting top talent into engineering teaching careers. In 1967 the total bill for engineering faculty salaries should be $200,000,000, about three times the amount currently being spent. This is the prediction of the heads of the nation's engineering colleges, made in a report released on April 28.

By the 1966-1967 school year, the report finds, undergraduate engineering enrollment will be up 66 percent, and graduate enrollment will have doubled. This means that, by 1967, American engineering colleges will need 7,000 more teachers to bring the total of their faculties to 16,000. Salaries should average $12,500 in 1967 dollars, 105 percent more than today's average. The quality of our technological education in the next ten years depends critically upon meeting these needs, the report emphasizes.

Already, according to the engineering deans interviewed, across-the-board salary increases averaging about 40 percent are needed to make academic jobs competitive in total satisfactions with nonteaching opportunities. If general salary levels continue to rise, more increases will be needed to keep pace.

These are the conclusions of a two-year study, sponsored by a special Committee on Development of Engineering Faculties of the American Society for Engineering Education. The eight-member committee was headed by Dr. Harold L. Hazen, dean of the Graduate School at Massachusetts Institute of Technology. Financing for the study was provided by the National Science Foundation, with added grants from the Burroughs Foundation, the Leeds and Northrup Foundation, the Philco Corp., and the International Resistor Corp.

New facilities are important; more efficient use of present facilities and teachers will help; helping students finance their education is also important. "But," according to Dr. Hazen, "these things are meaningless if students in the future find as teachers only what is left after the cream of the ability has been skimmed." The central problem is adequate financing of faculties. "Our engineering educators fear most deeply of all the forced deterioration in quality inevitable when expedient rather than first-choice appointments is the pattern," Dean Hazen declared.

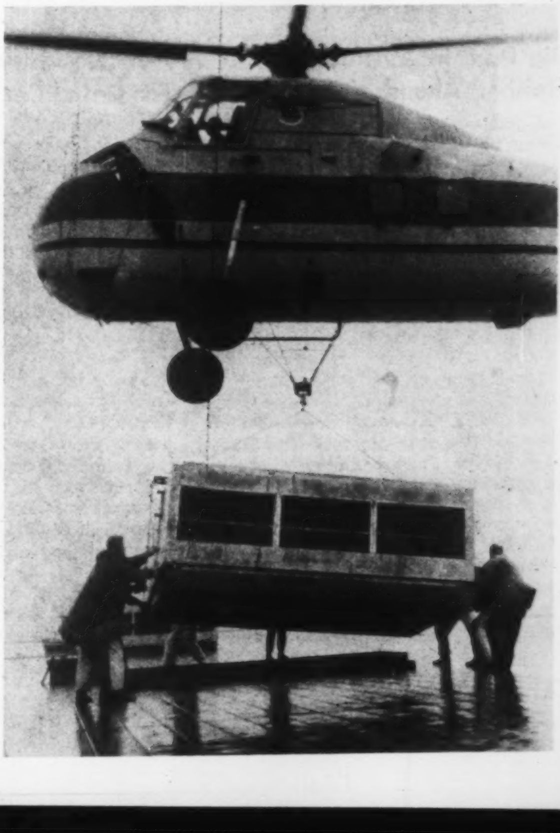
To be considered fully qualified as teachers, most engineering faculty members must have a doctor's degree. Only about 600 engineering doctorates are awarded annually, the committee found. Even if the entire number went into teaching, they would fill only two-thirds of the need for new teachers each year for the next decade. Unfortunately, 90 percent of these holders of doctorates normally go into industry. "We must find the means," said Dean Hazen, "to make careers in scientific and engineering education genuinely attractive to such first-rate minds as these."

The study on which the ASEE committee bases its conclusions was made by the Bureau of Business and Economic Research at Northeastern University. The project was carried out with the close cooperation of President Eisenhower's Committee on Scientists and Engineers.

Helicopter Speeds Mammoth Lifting Job

Helicopters have invaded the construction field and are performing all kinds of feats of lifting and placing that save time and money over conventional methods. In one recent time- and money-saving operation, a Sikorsky S-58 airlifted more than 100 tons of heating and ventilating equipment and spotted it on the 13-acre roof of the new plant being built north of San Diego by the Convair (Astronautics) Division of General Dynamics Corporation. Construction officials said the use of the helicopter "saved thousands of dollars" and enabled them to complete in seven flying hours a job that normally would have taken a month. Convair-Astronautics is producing the Atlas Intercontinental Ballistic Missile for the Air Force.

Sikorsky aircraft engineers envision a new crane helicopter designed solely for heavy lifting. Stripped of its cabin, the craft would provide plenty of room for the pilots, engines, rotors, and hoists. Such a crane helicopter could be used for airlifting construction equipment and personnel. Equipped with pods (large interchangeable carrying containers), it would also be invaluable to the military for moving large numbers of troops or in evacuating areas.



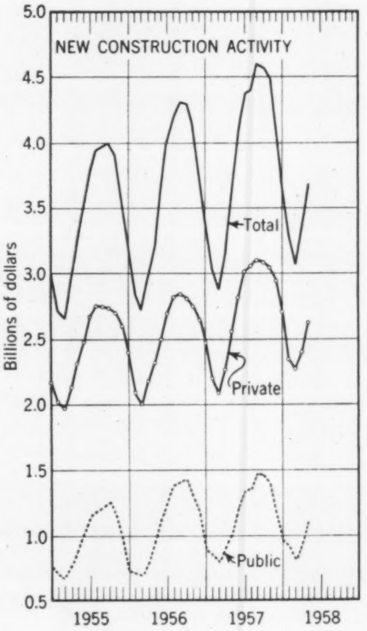
Helicopter eases 1½-ton cargo on roof of Convair - Astronautics plant, positioned to a tolerance of less than an inch. That was the guarantee made and kept by Rotor Aids, Inc., helicopter operators who conducted the airlift operation. Use of conventional crane equipment to hoist the 100 tons of heating and ventilating equipment would have necessitated reinforcing the roof with heavy planking. (Photo courtesy San Diego Union Tribune.)

Construction Activity Rises Seasonally in April

New construction activity rose seasonally in April to $3.7 billion, according to preliminary joint estimates of the U.S. Departments of Commerce and Labor. Although the total dollar volume for the first four months of 1958, at $13.4 billion, was up slightly from the comparable period of 1957, the physical volume of work put in place probably did not increase.

The latest estimates reflect a 5-percent rise in public construction from the first four months of 1957, due primarily to increased spending for highways and public housing (mostly Capehart projects for the Armed Services). Private construction outlays thus far in 1958 totaled the same as a year ago—$9.6 billion. Expenditures for residential building, which also remained unchanged, accounted for nearly half the private total in both 1957 and 1958.

The government's monthly estimates are determined primarily on the basis of past contract award movements, standard progress patterns, and assumed normal seasonal movements. They do not reflect special conditions influencing the volume of activity in any given month, such as unusual weather, materials shortages, overtime, work stoppages, and postponements. General indicators of future trends in activity are housing starts, contract awards, building permits, and materials output. Analyses of trends of activity should consider all these interrelated factors.



Slight seasonal rise in construction in April brings total dollar volume for first four months of 1958 to $13.4 billion, a slight increase over last year.

Big Dam In Australia Finished Ahead of Schedule

A joint construction group from the United States has just completed Adaminaby Dam, one of the key structures in the huge Snow Mountains irrigation and hydroelectric project under development in southeastern Australia. The work, which was started in May 1956, was finished two years ahead of schedule by the Kaiser-Welsh-Perini-Raymond group. The Snowy Mountains project is being built under the auspices of the Snowy Mountains Hydroelectric Authority.

Located on the Eucumbene River, a tributary of the Snowy River in New South Wales, Adaminaby Dam is one of the world's big earth- and rock-filled dams. It is over 380 ft high, has a base thickness of half a mile, and stores 3,000,000 acre-ft. A power plant, with four-generator capacity of 320,000 kw, takes water from the dam. The rock bolting for this plant was described in an article in the February issue (page 40) by Thomas A. Lang, associate commissioner for the Snowy Mountains Hydroelectric Authority.

New Skyscraper Slated For Grand Central Area

Construction of a $100,000,000 office building just north of Grand Central Terminal is planned by a New York City group, headed by Eric S. Wolfson, chairman of the board of the Diesel Construction Co. The group has negotiated an 80-year lease for the property with the New York Central and the New Haven Railroads.

The new structure, together with other skyscrapers being build in the vicinity, will completely transform the Grand Central area. The 50-story shaft of glass and aluminum, to be known as "Grand Central City," will be erected on the present site of the six-story Grand Central Terminal Office Building. With more than 3,000,000 sq ft of rentable space, the proposed skyscraper will contain three legitimate theaters, an open-air restaurant, and a 2,000-car parking garage.

According to Mr. Wolfson, famous Grand Central Terminal itself will not be affected by the change. It is expected that traffic into and out of the terminal (550 trains a day) will continue on schedule while the foundations of the present Grand Central Terminal Office are being ripped out of the bedrock alongside the tracks and the new building constructed over them.

Army Gives Large Order for Shovels

The Quick-Way Truck Company, of Denver, Colo., has received a $12,000,000 U.S. Army contract for 400 truck-mounted shovels. Delivery is to start in January 1959 and continue at the rate of twenty machines a month until August 1960. The machines will be built to work in temperatures as low as 65 deg below zero.

At the option of the Army the contract may be increased by 25 percent.

Additional Financing for Illinois Toll Highway

Between $60,000,000 and $65,000,000 in additional financing will be sought by the Illinois State Toll Highway Commission to complete construction of the 187-mile Illinois Tollway. According to Austin L. Wyman, chairman of the commission additional revenue bonds will be offered for sale later in the year. Issuance of additional bonds was made necessary by rising construction costs.

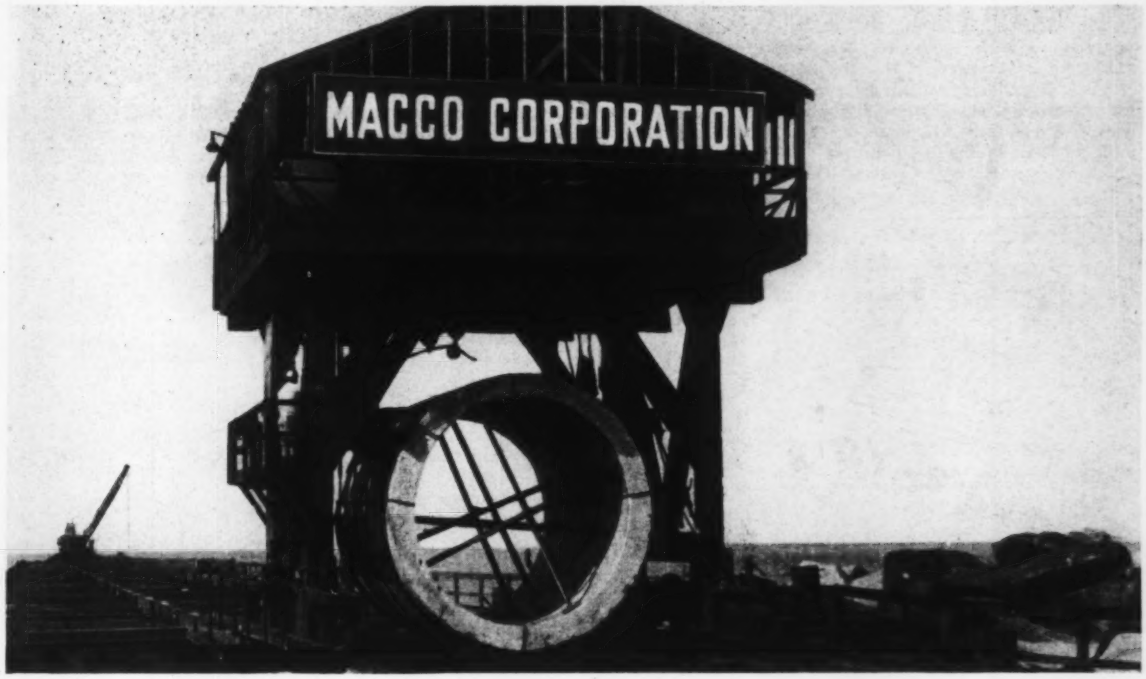
Mr. Wyman has also announced that, on the basis of a resurvey of traffic and earnings completed in February, recommended toll schedules have been revised. Charges for passenger vehicles will be nearer two cents a mile than the cent and a half originally recommended by traffic engineers. On the basis of the revised toll structure, the traffic report estimates gross earnings of $23,600,000 for 1959, rising to $47,200,000 in the tenth year of operation.

New Name for Raymond Concrete Pile Company

The Raymond Concrete Pile Company has changed its name to Raymond International Inc. At their annual meeting in New York on April 2 stockholders voted in favor of the Board of Directors' recommendation to make the change. The decision in favor of the change was based on the belief that, while a name descriptive of the company's field of specialization is advantageous in the United States, it hurts foreign sales.

As a division of Raymond International, the Raymond Concrete Pile Co. will continue its operations in the United States, while Raymond International will handle foreign business. In its home operations, the 60-year-old company will continue to offer its present services, including foundation piling, underpinning, and soil investigation.

Know-How MEANS EVERYTHING IN SUBAQUEOUS PIPELINE INSTALLATION



Over the past 30 years, MACCO experience and job-bred know-how have been employed on six of the most important subaqueous pipeline projects on the West Coast. These projects involved the laying of 22,800 lineal feet of subaqueous pipeline 10 to 14 feet in diameter under the Pacific Ocean in water depths to 65 feet below MLLW.

However, due to MACCO'S resourceful planning, these subaqueous projects were completed on schedule—and at minimum cost.

When the laying of 4600 feet of 120″ ID concrete subaqueous cooling water circulating lines, an integral part of the Southern California Edison Company's 350,000 KW steam plant at El Segundo, California, demanded special equipment—MACCO men designed and constructed this special equipment. A combination wood and steel trestle, self-propelled crane undercarriages, dredge pump excavation eductors and a 100-ton Diesel electric pipe gantry were engineered and constructed by MACCO.

MACCO *has* the job-bred know-how, plus the specialization and diversification necessary to design and construct your requirements economically and in the shortest possible time. We're capable... and we're interested in working for you.

MACCO

MACCO CORPORATION

14409 South Paramount Boulevard • Paramount, California

RECENT MACCO SUBAQUEOUS PIPELINE PROJECTS

SCATTERGOOD STEAM GENERATING PLANT
Playa del Rey, California
for Los Angeles
Department of Water and Power

STEAM GENERATING PLANT
Huntington Beach, California
for Southern California
Edison Company

STEAM GENERATING PLANT
El Segundo, California
for Southern California
Edison Company

STEAM GENERATING PLANT
Redondo Beach, California
for Southern California
Edison Company

Pakistan Carries Out Roadbuilding Program

Two 400-mile road projects are currently underway in Pakistan, according to Pakistani engineers in the United States to study our methods of highway construction. The larger of the two projects is a 450-mile coastal highway, which will connect Pakistan, Iraq, and Turkey. The three countries will share the $95.3 million cost. Preliminary surveys are underway for the road, which will be surfaced with asphalt.

The second project is a 435-mile blacktop highway, which will reduce driving distance between Karachi and Quetta by 110 miles. Starting as a single-lane project, this road will be widened later to 24 ft. The total cost will be about $13,000,000. The U. S. Bureau of Public Roads has been aiding in the building of a demonstration portion of the road, with the International Cooperation Administration supplying funds for machinery.

N*G*Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"I had a little help from Otto," confessed Joe Kerr, "but I figured the Voluntary Fund."

"Otto?" asked the Professor. "Do I know him?"

"Otto Maishin. He programs the hightronic computer at the Highways Electronic Lab. We programmed your problem

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by ciphering the letters ACDEIORST with the gamut of numbers with 9 different digits from 102 345 678 to 987 654 321. Working 6 multiplications a second, the computer tried them all in a week and rang the bell only once. So I . . ."

"A week!" jeered Cal Klater. "I did it in 20 minutes. Since S • T ≡ E, to modulus 10, and S+E ≡ R, neither S nor T can be 0, 1 or 5. Hence for O+S ≡ O there must have been one to carry, and S=9. Next, A> O> T, so T< 7. Trying in turn T=2, 3, 6 in partial multiplication, and noting that E = 10 − T:

```
 ...899     799     499
     22      33      66
 ------     ---     ---
 ...798     397     994
 ....98     97      94
 ------     ---     ---
 ....778    367     934
```

These would make the letter O equal R, T or S, respectively, so these trials can be rejected, leaving only T=4, E=6. Using those to find R=5, O=7 and substituting,

```
 699      ..5699
  44          44
 ---     -------
 796      74 • 796
 96      74 • 796
 ---     -------
 756     ..7 • 756
```

and the rest fills in uniquely to find $81,707.56 in the Voluntary Fund. Just imagine Joe spending a week on a simple little thing like that!"

"Not me — the machine," protested Joe. "I didn't even waste the 20 minutes that Cal did and I got the same answer."

"Which is the only answer," concluded the Professor. "Now let's . . ."

"Question!," called Phil Adelfan. "Was there a hidden meaning to the cipher set-up? Like 'A caress to tease makes an otiose couple which fails to adore because the C.O. was there'?"

"Silly, but I like it. As I was saying, let's change jobs. The unique set-up you just solved was a random number, the amount of the Voluntary Fund on January 31. An equally random number is the amount to which it had grown on March 31, $82,555.90. Let's see you set up a multiplication in cipher leading to this number uniquely as the product. And, Phil, if you want to hide a silly meassage in the set-up, don't let the three 5's stop you. You can use hyphenated words like free-end, butt-top and well-log, or that bit of TV onomatopoeia, smo-o-oth."

[*Hydra-headed Cal Klater was T. R. Anand, S. K. Rueball (Keith Jones), Ed C. Holt Jr, John A. Scoville Jr, J. Barnsworthy Pipsqueak (W. C. Strasser), Manuel A. Benson, William R. McGrath, Thatchrite (Guy C. Thatcher), S. L. Dum (T. M. Borman), Laurence V. Degnan, Thomas M. Morgan, Rudolph W. Meyer, H. Francis Finch, Murray Bornstein, Al Gorithm (Lawrence Goodman), Florian Bechtold, Richard Jenney, the Phil Adelfan, Carl B. Oustad, Julian Hinds, Del Awarian (George N. Hyland), Judson Ferentz, William F. Saunders, Turgut Sarpkaya, Karl M. MacDuffee, Lillard N. Sharpe, Vincent J. Vitagliano, Lawrence A. Starr, David V. Messman, and Erwin R. Bretscher.*

Also acknowledged are solutions of the problem of the starving xabs from James M. Gere, and of the best curved fence from Thatchrite.]

Japan Completes High Dam for Tokyo Supply

The $33,000,000 Ogochi Dam in Japan has been completed after almost two decades of intermittent effort. The 490-ft-high structure is the second highest in the country and one of the ten highest in the world.

Located on the Tama River on the western outskirts of Tokyo, the project will store 155,000 acre-ft of water for the municipal supply. While Ogochi Dam was developed primarily for water supply, it will also serve for flood control and power generation—19,000 kw currently under construction and a total of 41,000 kw planned. (See CIVIL ENGINEERING for February 1955, page 58.)

Breakthrough Ceremony At Fort Pitt Tunnel

A charge of dynamite set off by Governor George M. Leader of Pennsylvania, on March 31, eliminated the final 4 ft of rock and earth in the first tube of the 3,600-ft-long Fort Pitt Tunnel currently being bored through the base of Mount Washington, Pittsburgh. The breakthrough took place inside the exit portal of the northbound portion of the twin tube just 178 working days after the start of drilling operations last August. Work on the second tube, which will handle southbound traffic, is also well advanced.

When the $17,000,000 tunnel project is completed in February 1960, it will connect the east and west sections of the Penn-Lincoln Parkway. It is being built by the Pennsylvania Department of Highways, with the participation of the U. S. Bureau of Public Roads. Merritt-Chapman & Scott Corporation, of New York, is the general contractor.

Engineers Chosen for New Washington, D. C., Airport

Award of a contract to Ammann & Whitney, New York City consulting firm, for architectural and engineering work on the new Washington International Airport at Chantilly, Va., is announced by the Civil Aeronautics Administration. The contract covers the planning, design, and supervision of construction of the complete airport with all related services and facilities.

Associates of Amman & Whitney in the enterprise will be the engineering firm of Burns & McDonnell, of Kansas City, Mo.; and the architectural firms of Eero Saarinen and Associates, of Bloomfield Hills, Mich., and Ellery Husted, of Washington, D. C. The four firms have collaborated on a number of important projects.

Mr. Oliver Osborne and his clouded issue!

Mr. Osborne is a City Councilman—doing a big, important job. But he has a fierce problem. His city needs a new sewer system. The Council wants to put a Bond Issue before the voters.

But how does Mr. Osborne tell the voters: "This is the one time we pay to install a sewer line"?

In order to keep the Bond Issue as low as possible, cheap pipe is being considered. Main trouble is, cheap pipe is susceptible to corrosion failure . . . with subsequent dig-ups . . . that's not good in an area where growth is expected.

The "clouded issue" is basing a Bond Issue on pipe that won't do the job . . . that won't stand up . . . that breaks down, causes endless maintenance and eventual replacement. Like the man said: "Mr. Osborne, don't let them use a design theory based on the buck."

There's only one completely dependable answer . . . genuine Vit-Clay pipe by Gladding, McBean & Co. Acids and gases won't bother it a bit . . . never corrodes. Yes, Mr. Osborne can look to clay for 100 years of dependability. There's no sense clouding the issue at City Hall—in specifications or in design. Particularly, when GMcB stands for *guaranteed* performance for generations to come and substantial savings over the long haul.

If you're in the position to help in any way with recommending, planning, engineering or installing sewage systems, talk over the community project with a nearby GMcB representative. He's had experience in the field with this clouded issue before!

Look for the pipemark of quality . . .
and the GMcB service
that goes with it

EXTRA GMcB STRENGTH

GLADDING, McBEAN & CO.
Pipe Products Division

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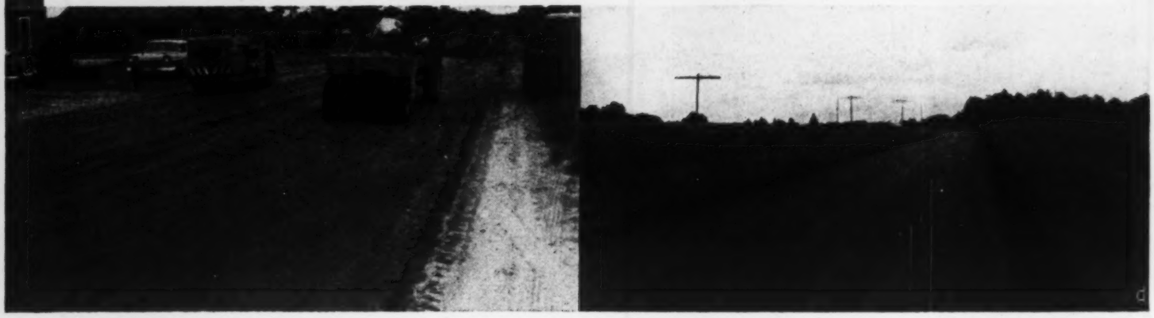
First Step in the Stage Construction of a Highway

Soil stabilization with Texaco Cutback Asphalt

b



a. Applying a medium-curing Texaco Cutback Asphalt to windrow of soil.

b. Pulvi-mixer and motor grader blend Cutback Asphalt and soil.

c. Compacting Texaco-treated soil with multi-wheel and tandem rollers.

d. Completed soil stabilization project in Wadena County, Minn.

Wadena County, Minn., is building this road by stages, thus spreading the cost over a period of years. Pictured here is the first stage. The cohesionless soil on the road is being stabilized by a thorough blending with a Texaco Medium-curing Cutback Asphalt. This transforms the formerly dusty, muddy road into a durable, waterproof, all-weather surface.

Eventually, when the increased volume and weight of traffic require it, the Texaco-stabilized surface will become the foundation for a heavy-duty, hot-mix asphaltic concrete wearing surface, two to three inches thick.

The new surface will form a close, lasting bond with the previously stabilized base. The result is a flexible, rugged pavement, which absorbs heavy impact year after year with a minimum of maintenance.

Whether you are building or improving a road, street, airport or parking area, there is a type of Texaco asphalt construction exactly suited to your requirements. These types range from heavy-duty paving for interstate highways down to an inexpensive surface-treatment to eliminate dust and mud. Helpful information on all of these asphalt types is supplied in two free booklets. Copies can be obtained without obligation by writing our nearest office.

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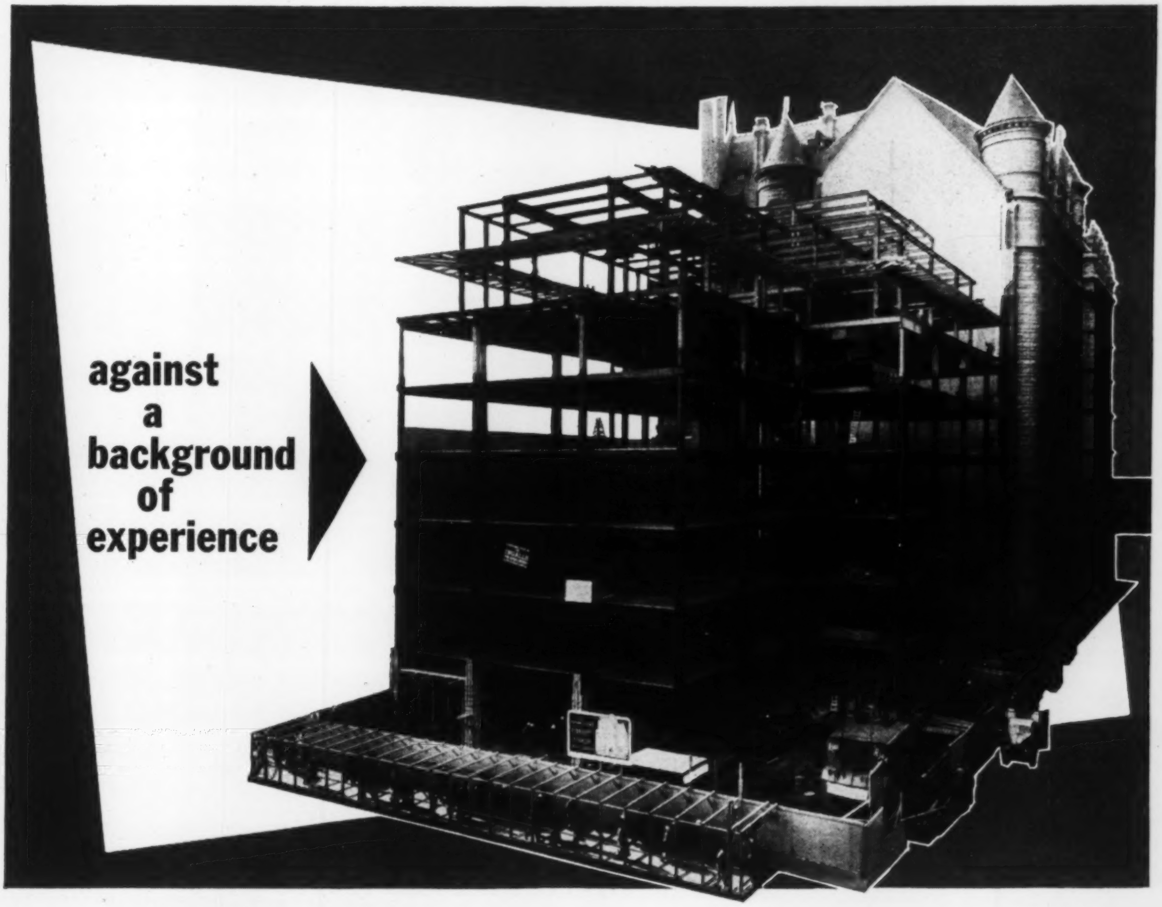
TEXACO ASPHALT



**STRUCTURAL STEEL
FABRICATED BY**

INGALLS

A striking contrast of the old and the new is provided by this photograph of the new building now under construction in Newark, New Jersey, being built by The Prudential Insurance Company of America for occupancy by Fidelity Union Trust Company. Over 1170 tons of structural steel for this clean-lined new building were fabricated by The Ingalls Iron Works Company. Readily available, structural steel is the choice of many architects and engineers when speed of erection must be combined with great strength and economy.

Call on Ingalls when your plans require structural steel. Ingalls, with over 48 years of steel construction experience, is today one of the nation's major fabricators. Ingalls' background of long experience and skillful performance can serve you—better.

**Built by The Prudential Insurance Company of America
for occupancy by Fidelity Union Trust Company**

Architects: Voorhees, Walker, Smith & Smith
Structural Steel: The Ingalls Iron Works Company

AISC
STEEL PLATE FABRICATORS ASSOCIATION
FOUNDED 1933

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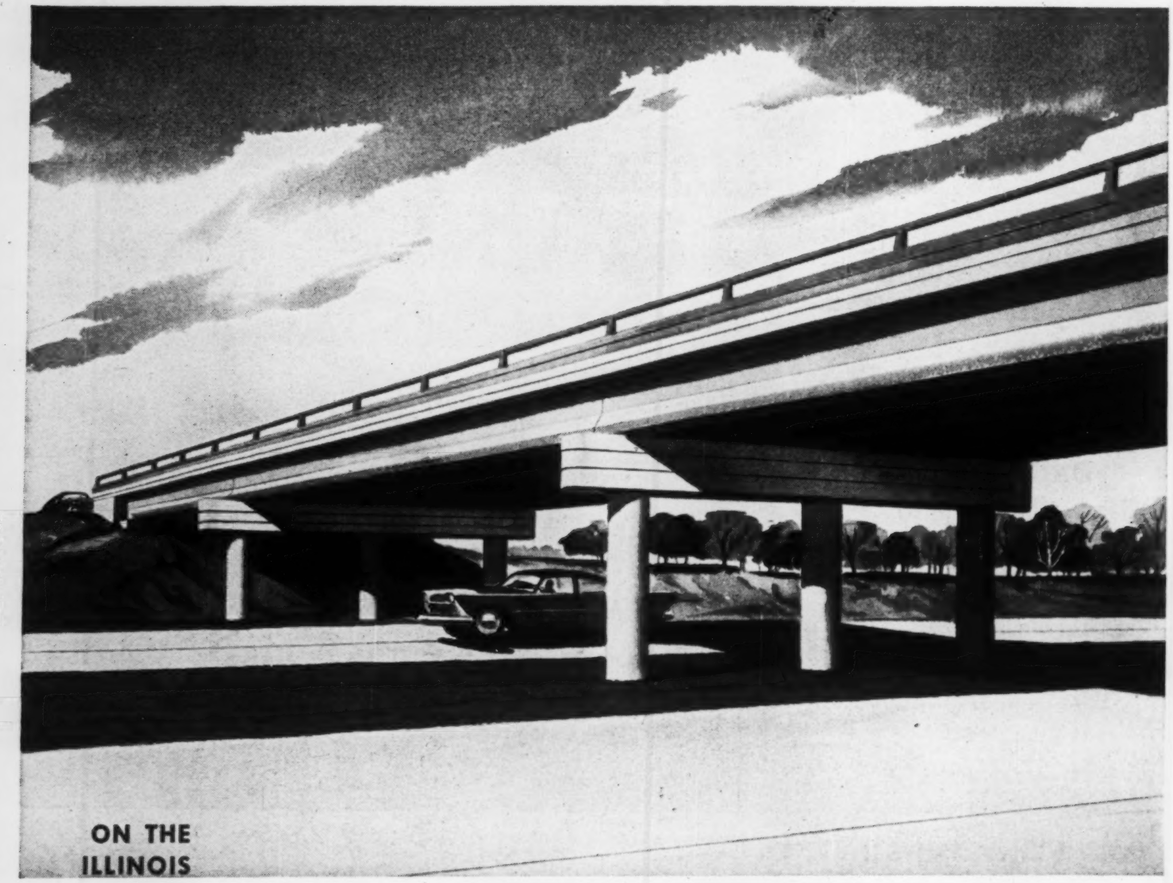
INGALLS
IRON WORKS
COMPANY
Executive Offices
BIRMINGHAM, ALABAMA

INGALLS INDUSTRIES ARE:
The Ingalls Iron Works Company, Sales Offices: New York, Pittsburgh, Chicago, Houston, New Orleans, Atlanta • **The Ingalls Steel Construction Company**, Sales Offices: New York, Chicago, New Orleans, Pittsburgh, Houston, Atlanta • **Birmingham Tank Company**, Sales Offices: New York, Pittsburgh, Chicago, Atlanta, New Orleans, Pascagoula
The Ingalls Shipbuilding Corporation, Shipyards: Pascagoula, Mississippi; Decatur, Alabama • Sales Offices: New York, Chicago, Washington, Houston, New Orleans, Atlanta

WHEN AMERICA BUILDS FOR ECONOMY . . . IT BUILDS WITH CONCRETE



ON THE ILLINOIS TOLL HIGHWAYS . . . precast, prestressed concrete for bridges will reduce costs $4,000,000

A full-scale test bridge showed engineers new ways to cut costs. 218 more prestressed bridges will follow . . . at savings that make every fifth bridge free!

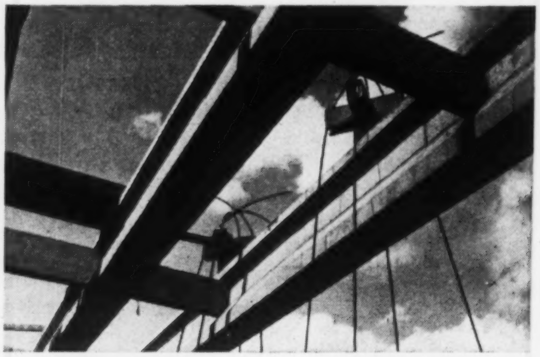
Engineers found big economy when they checked prestressed concrete for bridges on Illinois Toll Highways. They're cutting approximately $4,000,000 from original estimated costs—with no sacrifice of strength or durability.

This is a mass production job, the biggest yet of its kind. Designs are standardized. Prestressed stringers are being produced in casting yards to achieve top economy and uniformly high quality. All this enables contractors to meet road opening schedules with resultant financing economies.

Whether the job calls for hundreds of bridges or just a few, savings really add up with prestressed concrete. And savings are just starting! Maintenance costs will be the lowest known on any major bridge system. That's why you'll be seeing more such modern bridges as Interstate System construction moves ahead.

PORTLAND CEMENT ASSOCIATION

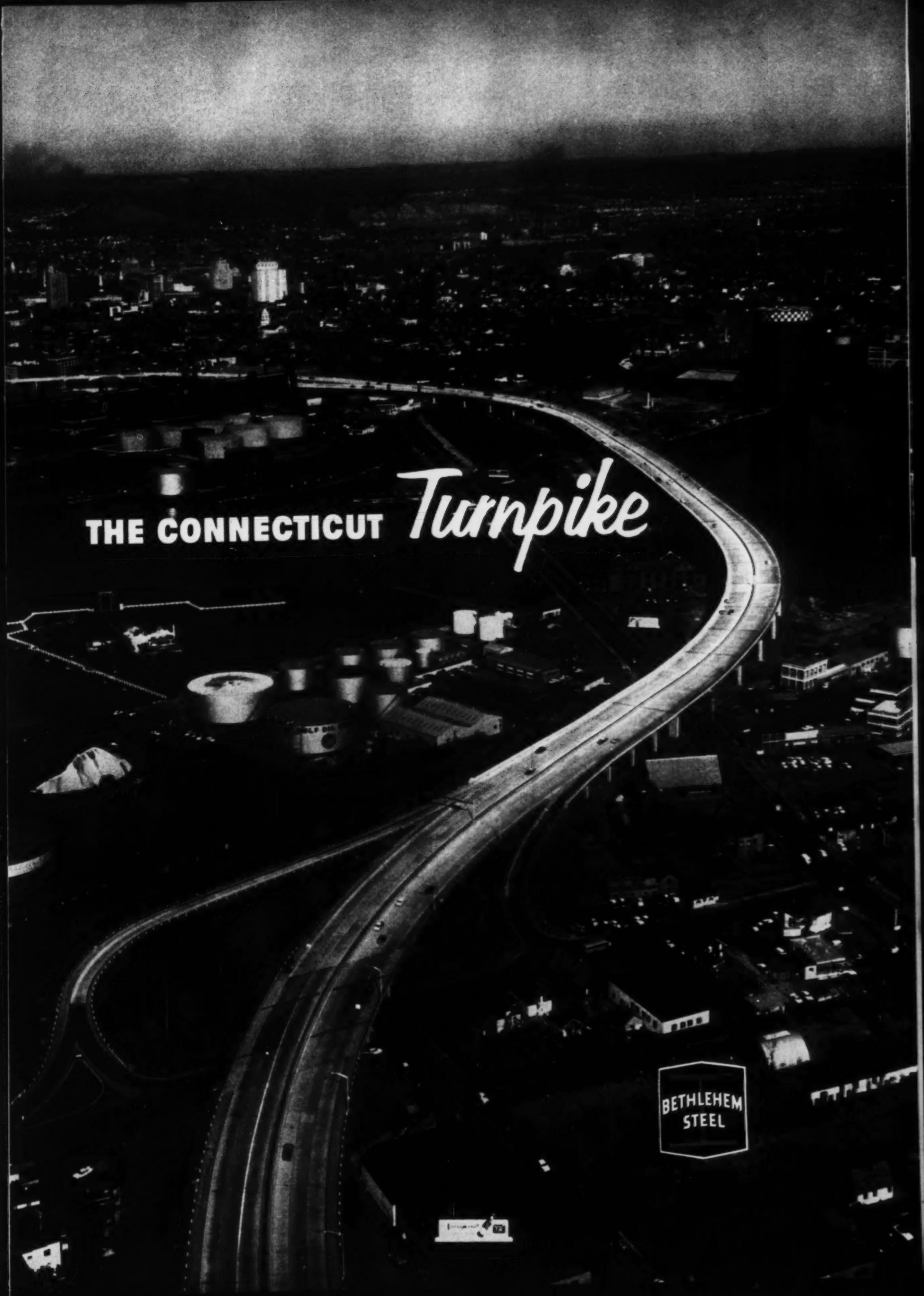
A national organization to improve and extend the uses of concrete



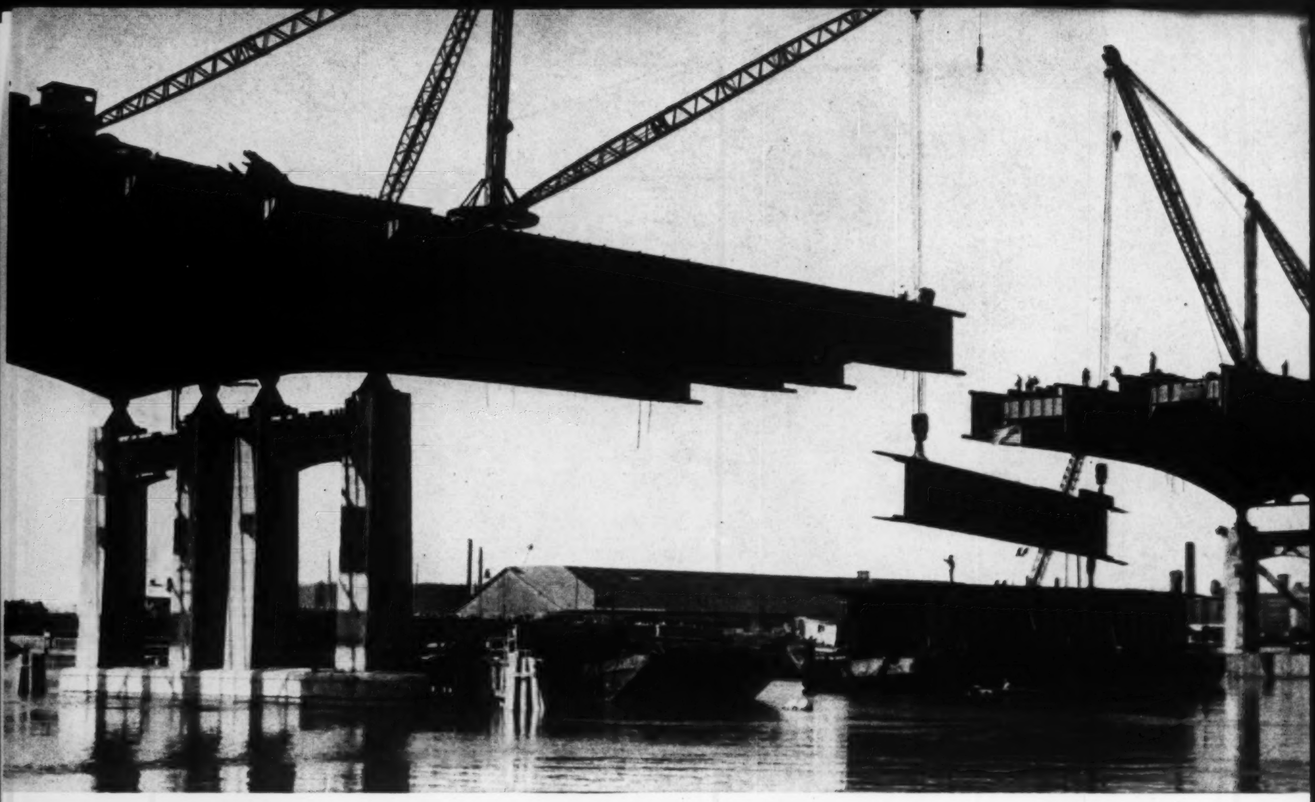
Beverly Road test bridge. Tests proved value of prestressed concrete for economical highway bridges.

FOR STRUCTURES . . .
MODERN
concrete

THE CONNECTICUT *Turnpike*



BETHLEHEM
STEEL



NEARLY A QUARTER OF A MILLION TONS OF STEEL HELPED BUILD 129 MILES OF TURNPIKE

Some 8,000,000 vehicles are expected to use the Connecticut Turnpike this year. Officially opened on January 2, it is the state's largest public works project to date, costing almost $464 million.

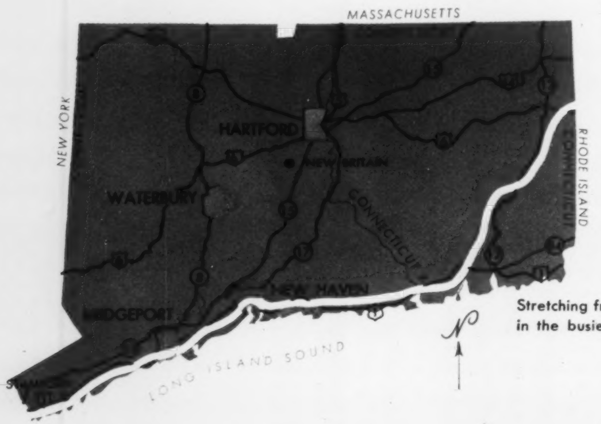
Slashing travel time between New York and the Rhode Island border, this new coastal expressway provides 129 miles of modern divided highway, with up to eight lanes in the busier sections. From start to finish, Connecticut State highway engineers kept safety foremost in their planning and design. Free of cross traffic for its entire length, traffic flows on and off through ninety interchange points. There are 198 spans to carry the expressway over railroads, streets, rivers and highways, and 76 other structures which carry roads over the Turnpike.

Everywhere along the Turnpike are evidences of steel's part in making the expressway a reality. Some of these are major structures, like the Quinnipiac River Bridge, longest continuous plate-girder span in the United States. Some 11,520 tons of structural steel went into this bridge, fabricated and erected by Bethlehem.

But steel is also present in less spectacular ways. Over 2½ million square yards of pavement reinforcement were used—some 8,000 tons—to strengthen the concrete slabs. Steel guard rail, both cable and beam, has a lineal length of some two million feet. Right-of-way steel fence stretches along 83 miles of the highway. Over 130,000 ft of steel bridge railing was used.

Steel was used in such varying applications as maintenance garages, restaurants, signs and signposts, culvert and drainage systems, toll booths and weight scales.

Bethlehem supplied a large part of all the steel used in the Connecticut Turnpike. Bethlehem supplies a long list of steel products for the construction industry (see page 4). And manufacturers of other types of highway products and construction equipment use many forms of steel made by Bethlehem.



Stretching from New York to Rhode Island, the Connecticut Turnpike is eight lanes wide in the busier sections. There is an average of one interchange for each 1.4 miles.

There are many and varied ways in which steel and steel products were used after the roadway was completed. Obvious applications are the toll booths, restaurants, garages, direction signs, weight scales, snow removal equipment and many others.

A COMPLETE LINE OF CONSTRUCTION STEEL

NORWALK TOLL
EXACT CHANGE LANE
STOP

PILING

STRUCTURAL SHAPES

FABRICATED STEEL

ROAD STEELS

WIRE ROPE

HOLLOW DRILL STEEL

Bethlehem furnishes a complete line of products for the construction industry:

Abrasion-resisting steel
Bar mats and welded fabric
Barbed wire
Blast furnace slag and commercial stone
Bridge floor
Bridge rail
Cables for suspension bridges
Center strip and keyway
Centering, solid steel over joints
Culvert sheets, galvanized
Curb facing
Digging bars
Drill steel, hollow and solid
Dowels, hook-bolt
Dowel units
Fabricated steel bridges and buildings
Fasteners of all types
Fence and posts
Form stakes
Form wire
Guard rail—beam and cable
Hardware, timber bridge
High-strength bolts
Joists, open-web, shortspan and longspan
Nails
Paving steels
Piling, steel sheet and H-piles
Pipe, large-diameter welded
Pipe piles
Pipe
Plate
Posts, steel fence
Posts, steel guard rail
Reinforcing bar accessories
Reinforcing bars, plain and fabricated
Rock bolts
Roofing and siding, steel
Structural steel shapes
Tool steel
Tunnel-liner plates
Tunnel ribs
Tunnel segments
Wire rope and slings
Yieldable arches for tunnel roof support

Descriptive literature is available on most of these Bethlehem products. And our catalog, "Steel for Highways," provides details on many of the steel products which are used in highway construction.

If you'd like more information, just fill out the coupon below.

You may want to see the new Bethlehem motion picture "Steel in Concrete," a technical study of reinforcing steel. This and other Bethlehem films are distributed through Modern Talking Picture Service, Inc. with offices in most major cities.

Bethlehem Steel Company
701 E. Third Street
Bethlehem, Pa.

Please send me literature describing: ____________

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BETHLEHEM STEEL

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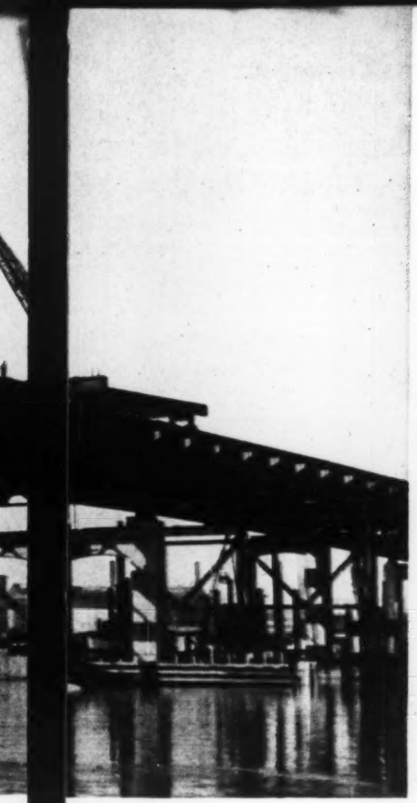


The Quinnipiac River Bridge at New Haven is one of the major structures on the Turnpike. The bridge's 387-ft-long center span is the longest continuous plate-girder span in the United States. Bethlehem fabricated and erected 11,520 tons of steel for the bridge, and supplied steel for many other of the 274 bridges and viaducts.

TURNPIKE FACTS AT A GLANCE

Conceived and operated by Connecticut State Highway Department
Towns and cities served—28 • Length—128.66 miles
Bridges and viaducts—274 • Total distance lighted—53 miles
Interchanges—90 • Dual service stations—7 • Restaurants—8
Toll stations—8 • Shoulders—10 ft wide • Lanes—12 ft wide

CONSTRUCTION FACTS AT A GLANCE

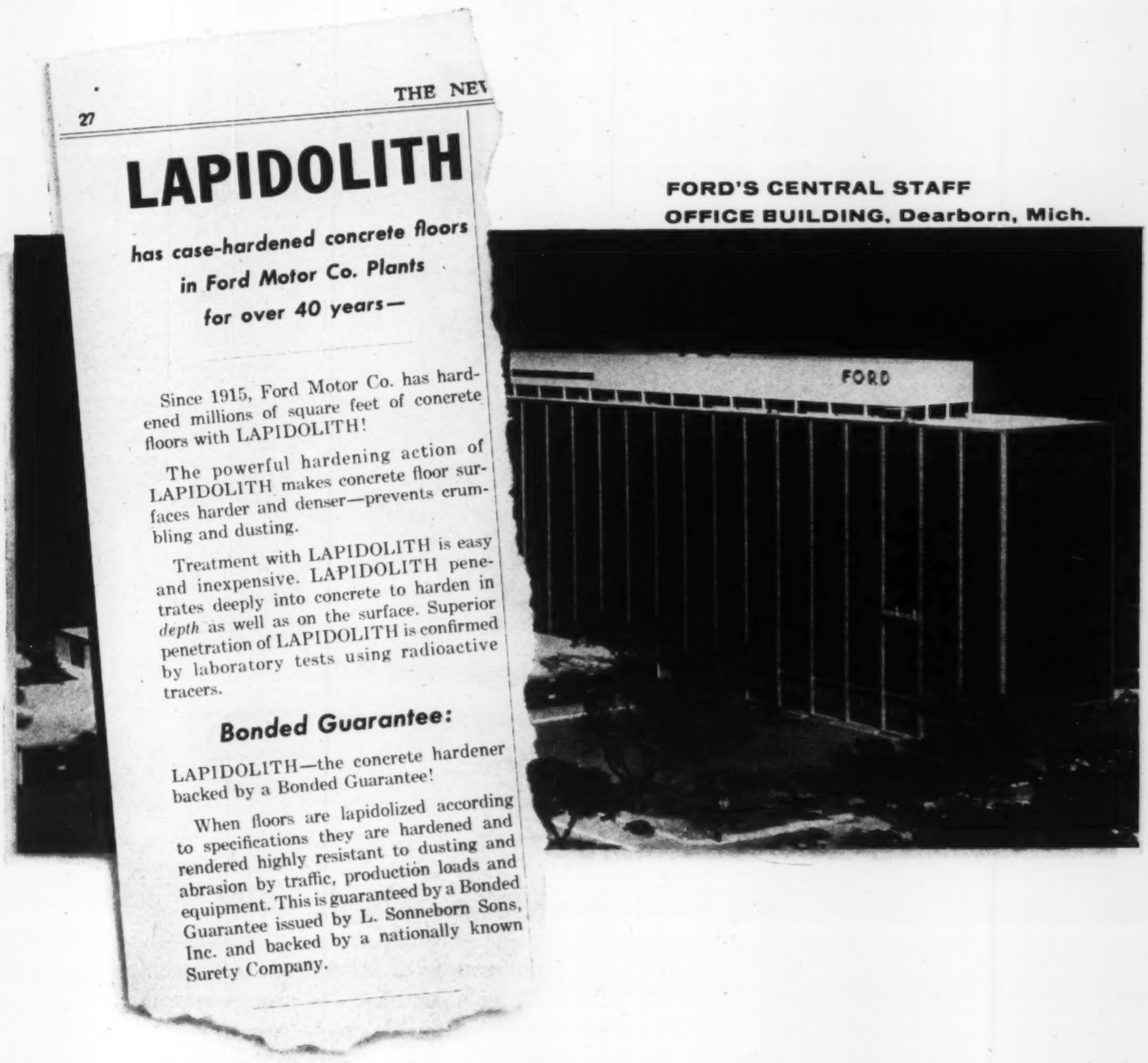
Portland cement used—2,309,500 bbls
Concrete for structures—722,600 cu yds
Concrete for pavement—684,900 cu yds
Rock excavated—9,182,000 cu yds
Earth excavated—16,744,300 cu yds
Steel required:
Fabricated structural—122,700 tons • Piling—46,000 tons
Pavement reinforcement—2,652,000 sq yds
Reinforcing bars—45,700 tons • Guard rail—2,151,300 ft
Fence—166 miles • Expansion and contraction joints—561,400 ft

Turnpike construction required the removal of over 9 million cu yds of rock. Bethlehem drill steel was widely used in drilling blast holes. And Bethlehem wire rope is the muscle on power shovels and pile-drivers.

Nearly 50,000 tons of Bethlehem piling were used in preparing foundations for the Turnpike's major structures. In addition to H-piles, sheet-piling cofferdams facilitated construction of water piers for the bridges.

Paving of the Turnpike called for thousands of tons of Bethlehem concrete reinforcing bars, dowel units, bar mats, and hook-bolt assemblies. Steel pipe, sheets, and culverts were used in drainage systems.

Millions of feet of steel guard rail, both the cable and solid-beam types, protect motorists and truckers along the Turnpike. And over 130,000 ft of steel railing is used on bridges.



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has case-hardened concrete floors in Ford Motor Co. Plants for over 40 years—

Since 1915, Ford Motor Co. has hardened millions of square feet of concrete floors with LAPIDOLITH!

The powerful hardening action of LAPIDOLITH makes concrete floor surfaces harder and denser—prevents crumbling and dusting.

Treatment with LAPIDOLITH is easy and inexpensive. LAPIDOLITH penetrates deeply into concrete to harden in *depth* as well as on the surface. Superior penetration of LAPIDOLITH is confirmed by laboratory tests using radioactive tracers.

Bonded Guarantee:

LAPIDOLITH—the concrete hardener backed by a Bonded Guarantee!

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FORD'S CENTRAL STAFF
OFFICE BUILDING, Dearborn, Mich.

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☐ We would like a FREE floor inspection and recommendation by a Sonneborn Engineer. (Minimum floor area, 10,000 square feet.)

☐ Send FREE 128-page Building Construction and Maintenance Handbook.

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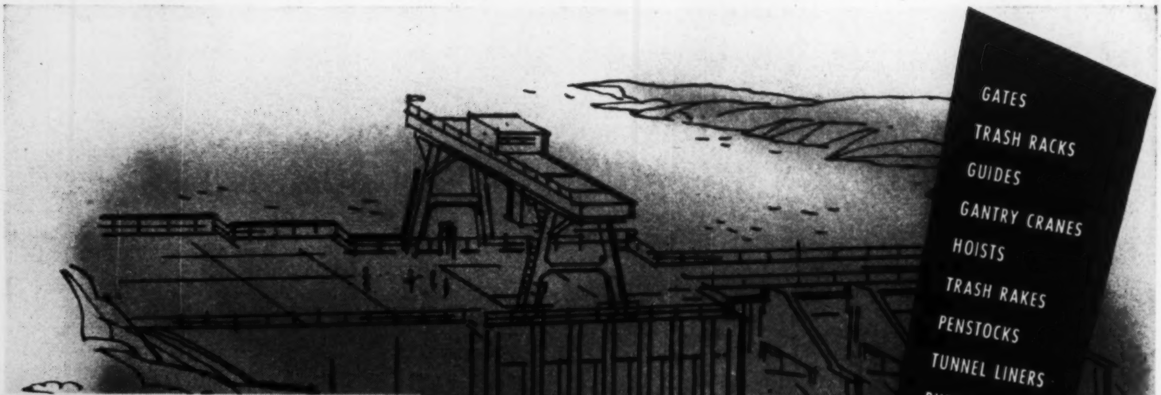

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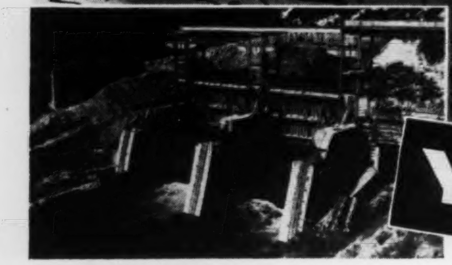
provides
the engineered fabrication
to harness hydroelectric power



Two of four radial gates, and structural steel for river dam project.

Part of 3,000 ton trashrack shipment.

105" Wye for western powerhouse.

As a major source of fabricated and machined components and assemblies – to any geographical location – Yuba offers through Calsteel, Yuba Manufacturing, and Adsco Divisions, a unique combination of experience, skills and facilities. Each has gained prominent recognition for products and services through many decades. Now integrated through Yuba Consolidated Industries, Inc., their combined know-how and facilities are available under a "package responsibility" – with the time-saving economy and convenience of working with a single organization as near as your telephone. Whatever your needs in harnessing the force behind hydroelectric power – you'll like doing business with Yuba.

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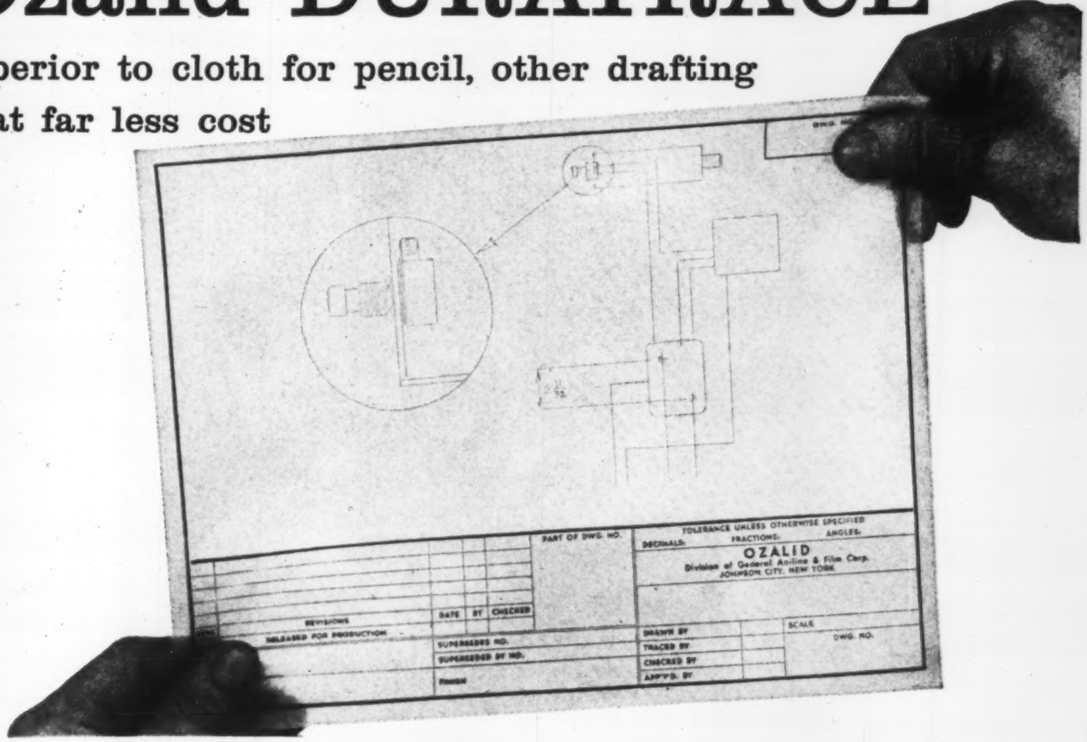
superior to cloth for pencil, other drafting —at far less cost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- **Gives you better prints, faster**
  The very high translucency of Duratrace means faster copying in your whiteprint or blueprint machine—copies with maximum contrast. Duratrace won't stretch, melt or peel in your copying machine. Distortion of drawings is ended.
- **Stands up to roughest usage—indefinitely**
  Easy to handle and file, Duratrace resists wear and tear—is almost ageless! Its fold and tear strengths far exceed those of cloth, most other films. Duratrace can't fray, become "dog-eared," crack, chip, or turn brittle. It's nonyellowing . . . *really* waterproof; can be filed indefinitely, without deterioration!

Why not test this advanced new drawing material and discover for yourself its many advantages and applications? Just mail the coupon and you will receive free sample and price information.

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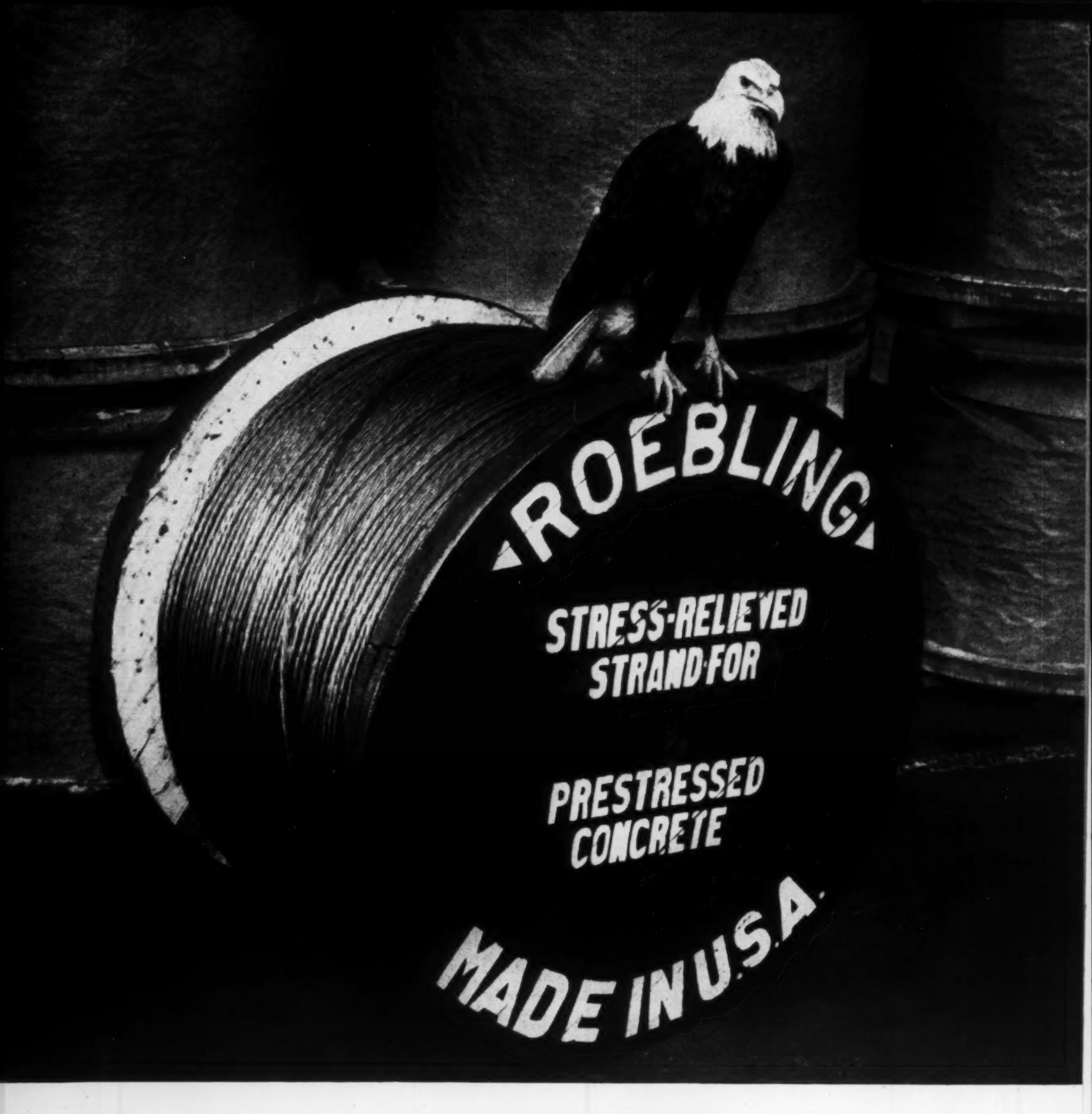

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The language of *service* and *engineering assistance* wherever and whenever you need them.

The reel of Roebling Stress-Relieved Strand for prestressed concrete that you see here is but one of many elements of prestressed concrete . . . every one of which Roebling is familiar with and many of which Roebling has instituted and developed.

Fourteen years of experience in every aspect of the prestressed concrete field—tensioning elements, strand development, design procedures, the development and introduction of the stress-relieving process for the uniform behavior of tensioning wires and strands—enable Roebling to *deliver* much more than the strand on the reel.

This from the oldest manufacturer of wire rope in the United States: the highest quality stress-relieved strand delivered in a "package" you cannot get from any other source in the world.

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Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

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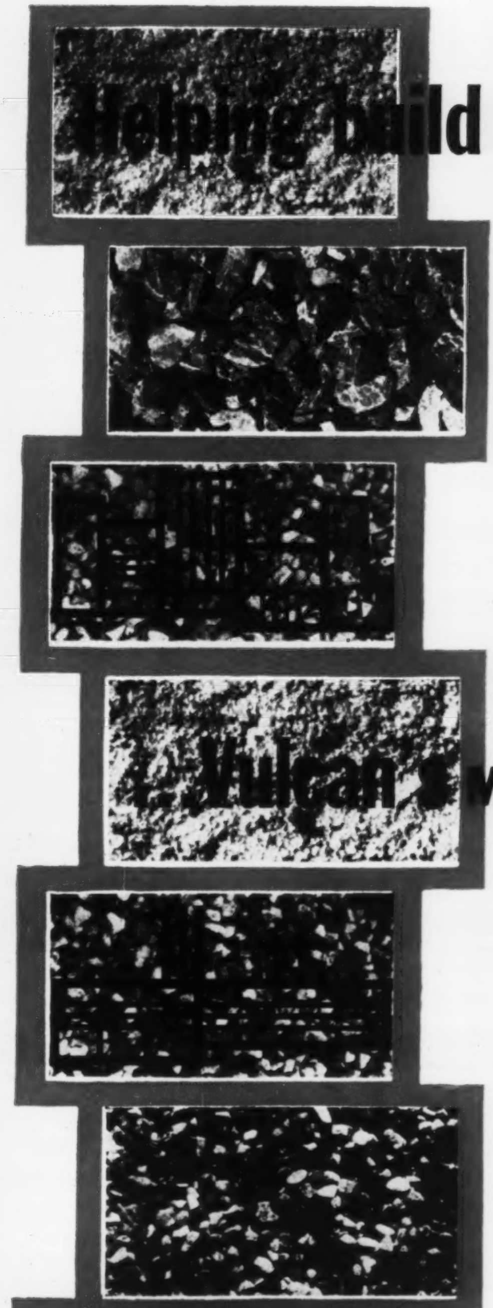
Consult Roebling . . . First in the U. S. with Prestressing and Tensioning Elements



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Here is a new concept of service to the building and construction industries.

Vulcan Materials Company operates plants and quarries strategically located from the Gulf to the Great Lakes . . . from Alabama and Georgia through Illinois and Wisconsin.

No longer dependent upon limited sources of supply, aggregates in any quantity can be shipped and delivered . . . anywhere and anytime.

Vulcan's Multiple Source Service!

Operating over fifty plants and quarries, Vulcan has the reserve of resources to fill your requirements and assure you of deliveries as scheduled.

When the job calls for sand, gravel, crushed stone or slag . . . call on Vulcan Materials' Multiple Source Service to serve all your needs.

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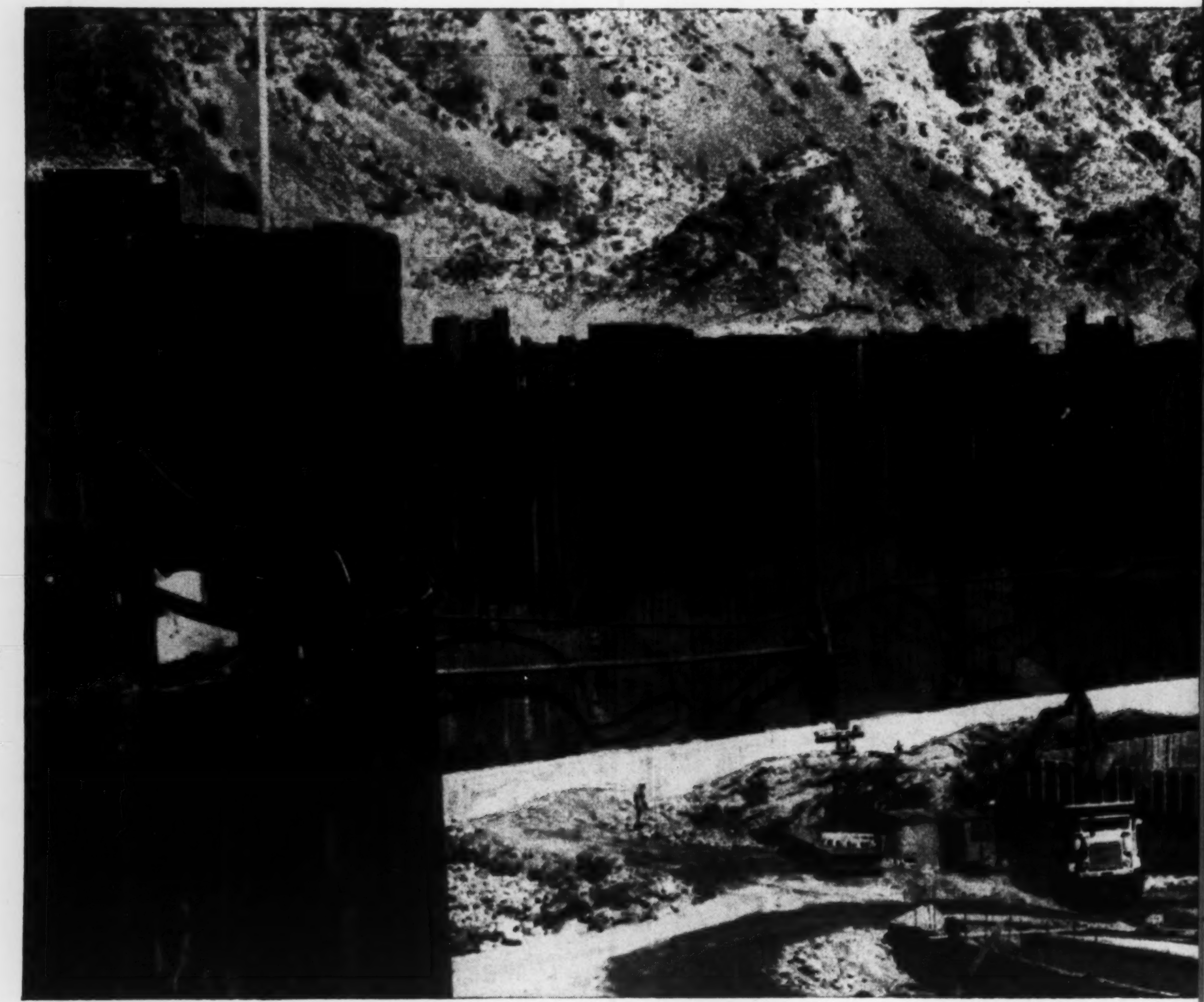
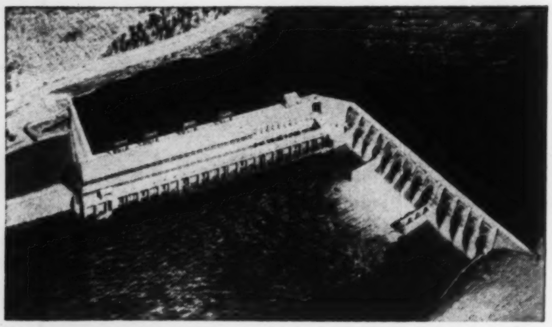


Cofferdam built tight and strong with USS MP-101 straight-web steel sheet piling.

5,600 tons of USS Steel Sheet Piling



Rocky Reach Hydroelectric Project, Public Utility District No. 1, Chelan County, Wenatchee, Washington. Ultimate capacity: 1,200,000 kilowatts; Length of dam: approximately 5,000 feet, including 2,000 feet water-impervious earth cut-off; Height of spilling from bedrock: 127 feet; Normal pool area: 9,000 acres.

Designers and Engineers: Stone & Webster Engineering Corporation

General Contractors: Rocky Reach Dam Builders (a joint venture of four widely known firms). Pile Driving Sub-Contractor: Lebouef and Dougherty Construction Co., Richmond, California

USS MZ Piling of the type used for permanent cut-off walls to obtain high beam strength.

delivered on time for quick erection at Rocky Reach Dam, Washington

The new $273,100,000 Rocky Reach Hydroelectric Project near Wenatchee, Washington, needed steel sheet piling to start the project before the beginning of the annual flood stage of the Columbia River. Five thousand six hundred tons of steel sheet piling was made in Pittsburgh and delivered on time.

The USS Steel Sheet Piling was used to construct a portion of the 24-cell cofferdam, upstream and downstream cut-off walls and east abutment dam. The cofferdam was built in 103 days, or one cell every 4 working days. For this, USS MP-101 straight-web piling, driven to solid rock for maximum strength in tension, was used. Lebouef and Dougherty Construction Co., pile driving sub-contractor, states that the sheet pile interlock sizing was excellent and the piling placed without difficulty.

The cut-off walls were built with USS MZ Piling for maximum beam strength. These were also driven to solid rock for a permanent installation.

This is another case that illustrates the excellent cooperation on deliveries made possible by U. S. Steel's large production facilities and attention to customers' needs. When you want any type of piling—steel sheet or H-beam bearing piling—get in touch with the United States Steel office near you.

USS is a registered trademark

USS

United States Steel Corporation, Pittsburgh
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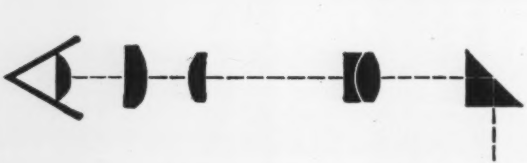

Two Gurley transits feature built-in optical plummets

Gurley OP-57

Gurley OP-137

The Gurley Optical Plummet Transit (Model OP-57) has proved itself to be such an important time and money saver in the field that this optical plummet feature has also been added to the Model 132 Standard Precise Transit. The new transit will be known as the OP-137.

Both these Optical Plummet Transits will save you time and trouble in setting over a point. The OP-57 and OP-137 eliminate the swing and sway of the cord and plummet—exasperating and time consuming. You will especially appreciate the increased accuracy on windy locations.

By rotating the instrument 180°, you can be assured of positive centering.

The Gurley Optical Plummet Transits are furnished with tripods which have built-in shifting heads. They allow a two-inch shift of instrument over the point, providing greater latitude in initial set-up.

Model OP-57 is recommended for very exacting work; the OP-137 for general engineering and construction work because of its shorter telescope, smaller size and its lighter weight.

Now in *two* models Gurley offers you an important advantage of the optical-reading theodolite *plus* the simplicity, ruggedness and proved performance of the American transit. *Write for new Bulletin OP-100.*

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W. & L. E. Gurley

Engineering Instruments Division

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Prompt Delivery of Basic Materials Speeds Opening of Highway 100 Bridge

Three-span, continuous, reinforced concrete, deck girder bridge carrying Route 100 over U. S. 52 and State Route 218. Inver Grove Township, near St. Paul. Designer: Minnesota Division of Highways.

Stay on schedule with REINFORCED CONCRETE

Bridges and highway separation structures are open for traffic on time when you design in reinforced concrete. Two important reasons for this are: (1) All construction material is available from local stocks, and (2) local labor is readily available for immediate construction. On your next bridge or overpass, design for beauty plus economy . . . and stay on schedule with REINFORCED CONCRETE.

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1924

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38 South Dearborn Street, Chicago 3, Illinois

DECEASED

Jean M. Allen (M. '28), age 79, Los Angeles consultant, died in Los Angeles, Calif., on April 12. Mr. Allen, who had studied at the University of Wisconsin, had served as superintendent of major dredging operations in Missouri, Illinois, New York and California. Before going into consulting work in 1921, he held the position of superintendent of harbor work in Manila. He was the designer and builder of 40 dredges of various types.

Millard H. Aubey (M. '51, age 48, Commander, Civil Engineer Corps, U. S. Navy, died in Rota, Spain, on February 28, while on active duty. Commander Aubey was a civil engineering graduate of Northeastern University. Before joining the Navy in 1942, he had been senior engineering aide and junior civil engineer for the Metropolitan District Water Supply.

Edward Bartow (M. '22), age 88, professor emeritus of chemistry at the State University of Iowa, died at his home in Iowa City on April 13. Dr. Bartow headed the chemistry and chemical engineering departments at the university for 20 years. He was a co-developer for the large-scale manufacture of a high explosive from corn. Dr. Bartow was a Phi Beta Kappa graduate of Williams College. He had taught at Williams, the University of Kansas, and the University of Illinois.

William G. Bratschi (A.M. '35), age 56, assistant hydraulic engineer with the U. S. Geological Survey in Santa Fe, N. Mex., died recently in Albuquerque. Mr. Bratschi was graduated from the University of New Mexico with a civil engineering degree. He had spent ten years with the state engineer of New Mexico. In 1939 he joined the U. S. Geological Survey, which he had served in several positions of responsibility.

Leon E. Chase (A.M. '28), age 58, engineer with Alvord, Burdick and Howson, Chicago, Ill., died at his home in Viroqua, Wis., on April 26. Mr. Chase, a 1922 graduate of the University of Wisconsin, had worked as a civil engineer on projects in Wisconsin, Illinois, and Michigan. He was post engineer at Camp McCoy, Wis., during World War II and at the Glenview, Ill., Naval Air Station, during the Korean War. He served as city engineer for Viroqua from 1953 to 1957 when he became connected with Alvord, Burdick and Howson.

George E. Clemens (M. '35), age 57, consulting engineer with the Economic Cooperation Administration in Paris, was killed recently in an airplane accident in the Belgian Congo. Mr. Clemens' early experience was with the Mississippi River Commission. He had held various positions on road and railway construction with the Corps of Engineers. During World War II, he served as a colonel of artillery, and as chief of construction for the Corps of Engineers in Germany. Later he was transport adviser for the E.C.A. in Europe. Mr. Clemens was a specialist in transport organization and author of several articles on waterway improvements and of many reports on African ports and railways. He had been active in the Mid-South Section which he had served as president.

Walter A. Conley (M. '21), age 76, consulting engineer in Morristown, N. J., died there on March 28. A graduate of Dartmouth College, Mr. Conley earned his civil engineering degree from the Thayer School of Civil Engineering. He had served as assistant to the consultant on the Queensboro Bridge, and as design engineer with James B. French, consulting engineer. In the nineteen-thirties, Mr. Conley began the practice of civil engineering in New York City and later continued as a consultant in Morristown.

George J. Davis, Jr., (M. '22), age 81, principal in George J. Davis & Son, Tuscaloosa, Ala., died there on February 28. Mr. Davis received his civil engineering degree from Cornell University and his doctor of science from the University of Alabama. Immediately after his graduation from Cornell, Mr. Davis taught at the University of Wisconsin. For over 35 years he served as professor of civil engineering and dean of the College of Engineering at the University of Alabama. In addition to his work as an educator, Mr. Davis took an active part in plans

(Continued on page 112)

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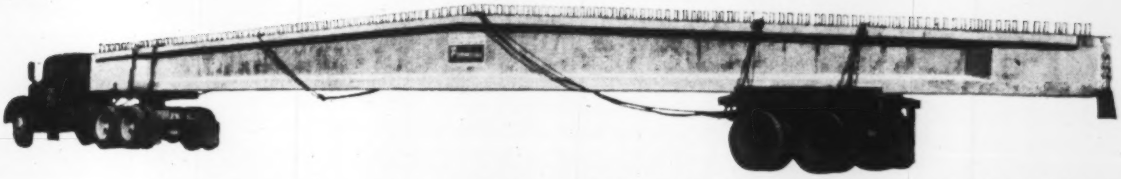
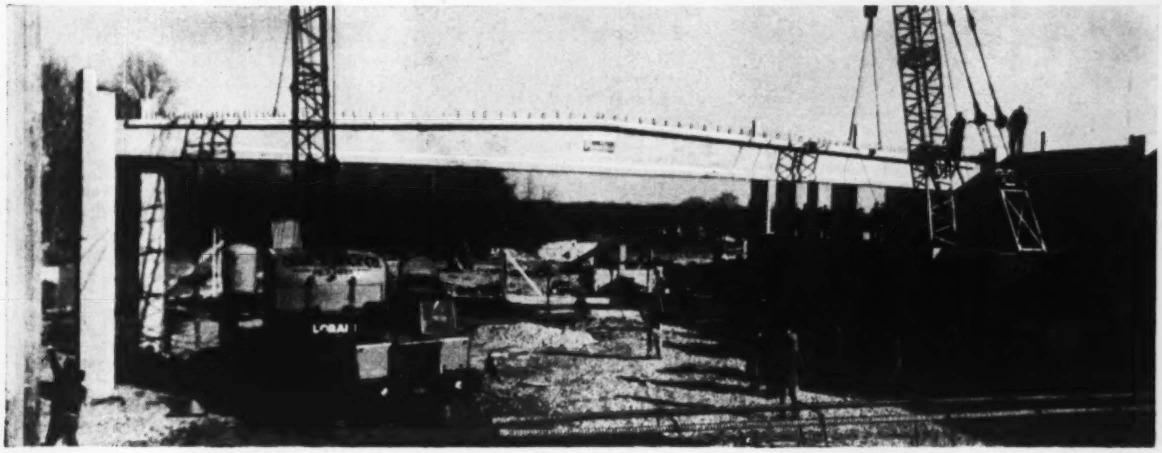


(Below) Positioning one of the four 97′ long, 32-ton prestressed beams for the gymnasium. Beams were trucked to job from manufacturer's Berlin plant.



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Contractor: Joseph Bahen Construction Co., Washington, D. C.
Structural Engr.: Carl Hansen, Silver Springs, Md.
Precast, Prestressed Units Manufactured and Erected by: Formigli Corporation, Berlin & Williamstown Junction, N. J.
Ready Mix Concrete for All Structural Units Supplied by: Trap Rock Industries Inc., Palmyra, N. J.

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This is another example of the advantages of precast structural concrete—and Lehigh Early Strength Cement.

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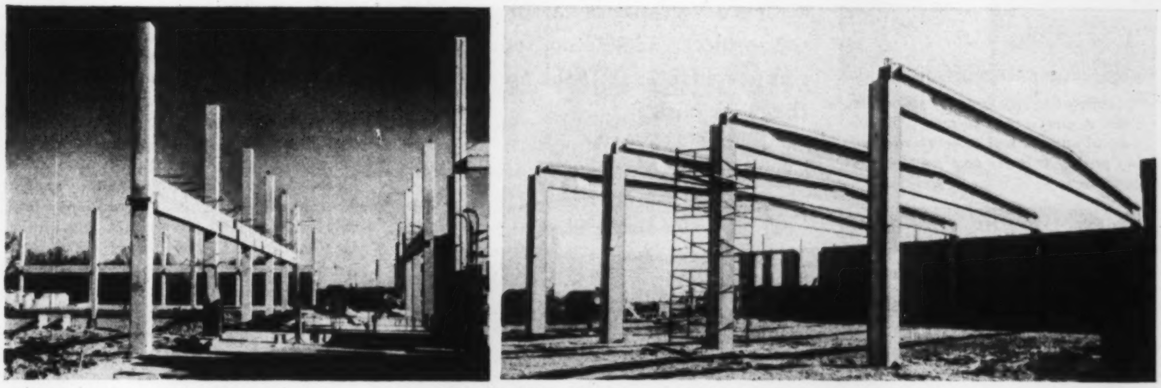

In addition to the four beams for the gymnasium (seen in photo at right), the school structural system required 72 precast columns, 114 spandrel beams, 190 lintels and sills, 2655 precast joists, and 1000 precast bridging pieces for the joists.

Box Canyon Dam Project for Public Utility District #1, Newport, Washington. Engineer: Harza Engineering Co. Construction Managers: Morrison-Knudsen Co.

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Vibroflotation in action at Box Canyon Dam. A compaction of over 550 cu. yds. of sandfill was maintained during each shift under adverse working conditions.

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(Continued from page 110)

and designs for a number of hydraulic and sanitary engineering projects. He opened his own firm about ten years ago.

Alden K. Fogg (A.M. '24), age 65, retired Naval officer and city engineer of San Diego, Calif., died there suddenly on April 25. Mr. Fogg had been city engineer since 1948, and was to have retired on July 1. In the Navy Civil Engineer Corps for 31 years, Mr. Fogg had attained the rank of captain at the time of his retirement. As public works officer for the Eleventh Naval District, he was in charge of the construction of a number of major projects, including the $15 million first San Diego aqueduct. As city engineer, he carried out an ambitious program of street paving and other municipal improvements. Mr. Fogg had been active in the San Diego Section, which he had served as president. He was a graduate of the University of Illinois.

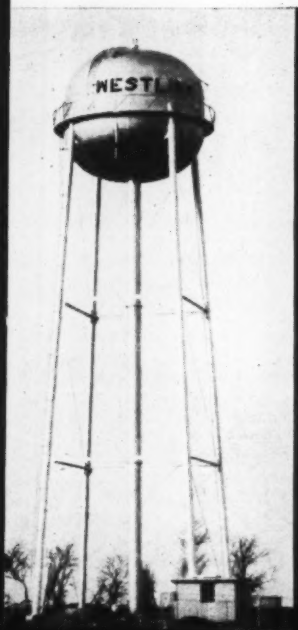
Charles W. Fowler (M. '55), age 72, consulting engineer of Washington, D. C., died there on April 12. Mr. Fowler was graduated from the Sheffield School of Science at Yale University. He spent several years in Puerto Rico working on the development of sugar refineries, and had been with the Irving Trust Company as a representative in the receivership division. Mr. Fowler had a consulting office in Washington for the past ten years.

William L. Havens (M. '25), age 64, partner in Havens and Emerson, engineers of Cleveland, Ohio, died there on April 26. Mr. Havens, a civil engineering graduate of Cornell University, was for many years senior assistant sanitary engineer for the city of Cleveland. He had also been associated with George B. Gascoigne in a consulting engineering practice. Mr. Havens had been a partner in Havens and Emerson since 1946.

Robert Hawxhurst, Jr., (M. '07), age 74, consulting engineer and geologist of San Francisco, Calif., died there on April 6. Mr. Hawxhurst had studied at the University of California and Stanford University. He spent the early part of his career in Hawaii, serving as assistant engineer for the Oahu Railway and Land Company; principal assistant engineer with the Hilo Railway Company; and principal in Whitehouse and Hawxhurst, Engineers and Contractors. He had studied and made reports on traffic conditions and coal deposits in the Philippines, ore deposits in China, and tin mines in Malaya. Mr. Hawxhurst had been engaged in consulting and geological work in San Francisco for more than twenty-five years.

(Continued on page 114)

KANSAS



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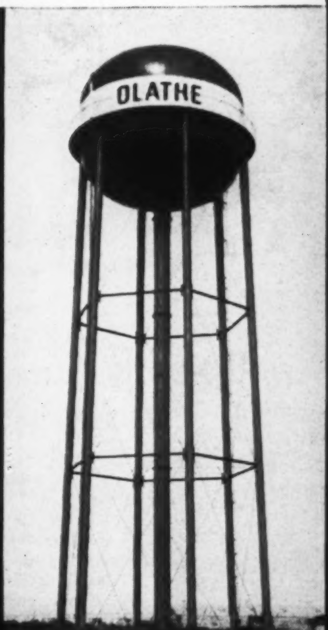

OLATHE
250,000 Gallons
Head Range 30′10½″

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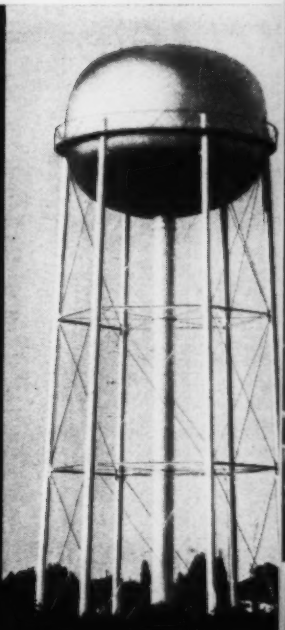
RACINE
150,000 Gallons
Head Range 24′9¾″



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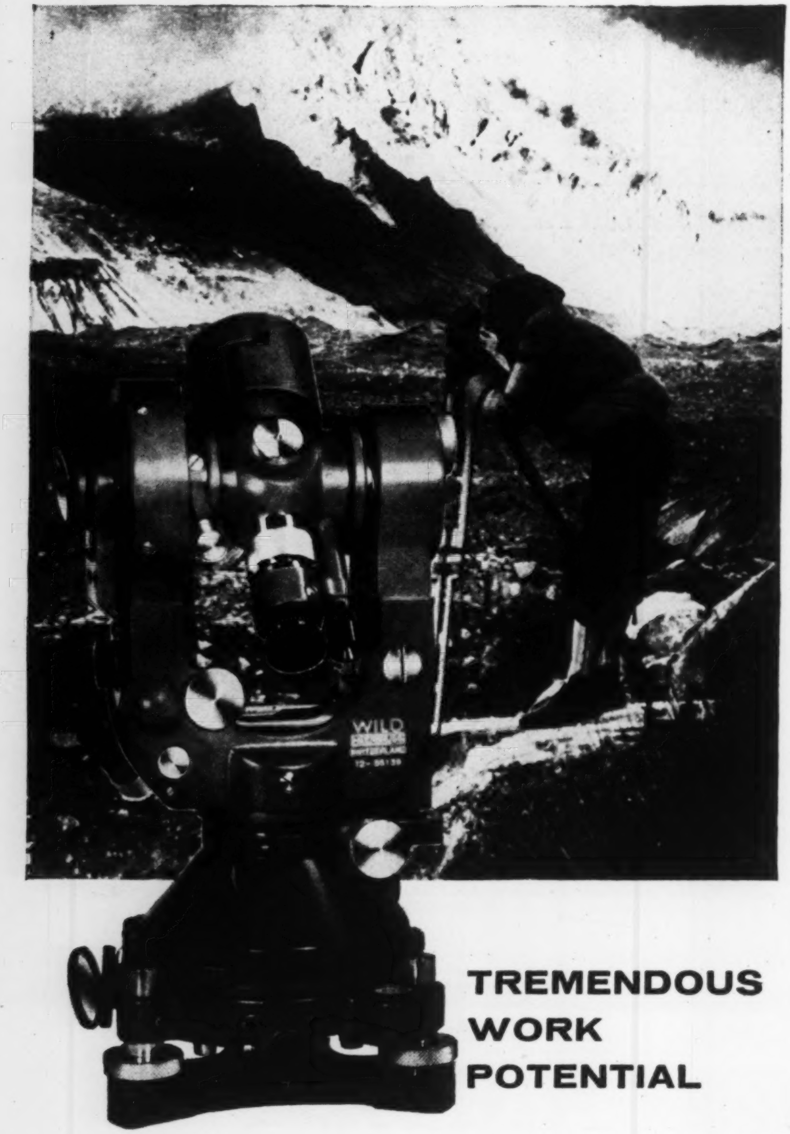

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(Continued from page 112)

Walter E. Irving (M. '38), age 85, founder and president of the Irving Subway Grating Company, Inc., Long Island City, N. Y., died in Stamford, Conn., on May 5. Mr. Irving graduated from Rensselaer Polytechnic Institute as a civil engineer, and in 1952, he was awarded the honorary degree of doctor of engineering there. An expert in steel flooring, Mr. Irving started his own iron works in 1902. In 1906 he introduced a riveted open mesh steel subway grating which transit officials hailed as the answer to pedestrian accidents. Mr. Irving was also the developer of the first practical emergency airfield landing mat. In recognition of his many contributions to safety, he received an Army Certificate of Appreciation for Patriotic Civilian Service.

W. E. Irving

William M. Jones (A.M. '24), age 61, retired treasurer of the John W. Ferguson Company, Paterson, N. J., died recently in Wilton, Conn. Mr. Jones received his civil engineering degree from Cornell University. He served with the Corps of Engineers during World War I. Mr. Jones was with the Ferguson Company for over twenty years in a number of responsible capacities.

Lawrence M. Kingsland (A.M. '37), age 61, senior civil engineer for the Transcontinental Gas Pipe Line Company, Houston, Tex., died there on April 15. Mr. Kingsland was graduated from Rice Institute with a degree in civil engineering. He began his professional career with the Texas Company, for which he worked in the United States and Venezuela. He had served several government groups, including the U. S. Geological Survey, the U. S. Forest Service, and the Corps of Engineers. He had been with the Transcontinental Company for almost ten years.

L. M. Kingsland

Jacob Mark (M. 40), age 71, New York consultant and head of Jacob Mark and Sons, died in Scarsdale, N. Y., on April 24. Mr. Mark, a native of Poland, received his engineering degree from the College of the City of New York. Shortly

(Continued on page 116)

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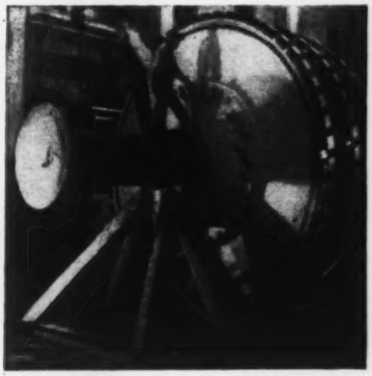

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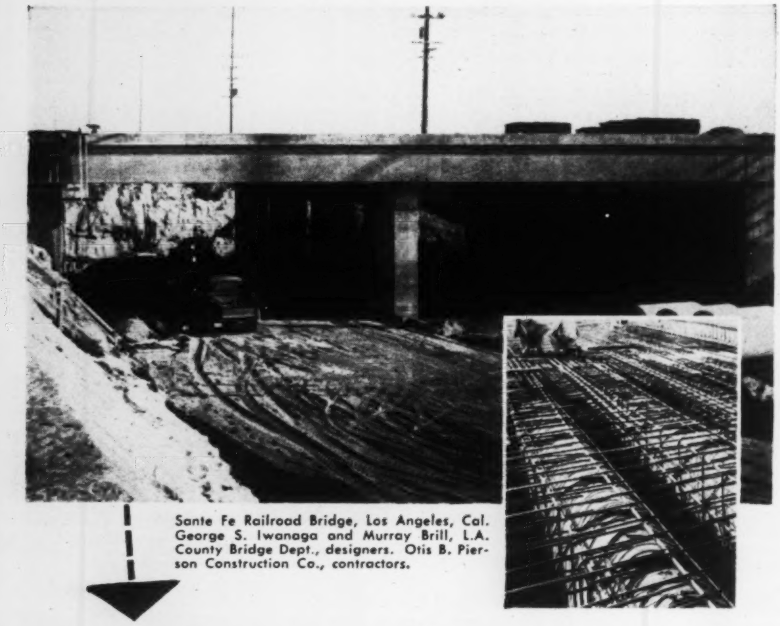

Sante Fe Railroad Bridge, Los Angeles, Cal. George S. Iwanaga and Murray Brill, L.A. County Bridge Dept., designers. Otis B. Pierson Construction Co., contractors.

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Construction Products

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Deceased

(Continued from page 114)

after his graduation, Mr. Mark established the Mark Iron Works in Brooklyn, which made ornamental gates and grilles. After the dissolution of the company, Mr. Mark worked for many years in the building field in Jacob Mark and Sons, building a number of major structures in New York and Brooklyn. Mr. Mark was a founder and director of the American Technion Society which was formed to aid the Institute of Technology in Israel.

William Mavila (J.M. '50), age 33, senior civil engineer and assistant to the Los Angeles County Engineer, died recently in Puente, Calif. Mr. Mavila was a graduate of Virginia Polytechnic Institute with a degree in civil engineering. Mr. Mavila served as engineer with John McShain, Inc., builders in Arlington, Va. He had been with the Los Angeles County Engineer for five years at the time of his death.

Robert R. Shoemaker (M. '43), age 60, chief harbor engineer for Long Beach, Calif., died there on January 26. Mr. Shoemaker, who had been chief harbor engineer since 1940, formulated and completed construction of all Long Beach's harbor development on Terminal Island, three bridges crossing the Los Angeles River, and many other projects in and around Long Beach Harbor. In addition to his work as chief harbor engineer, Mr. Shoemaker pioneered in the field of subsidence studies and, at the time of his death, was correlating a number of such studies for the Board of Harbor Commissioners. Mr. Shoemaker was a past president of the Los Angeles Section.

Carl W. Smedberg (M. '31), age 65, site engineer for the Public Housing Authority in Richmond, Va., died there on February 24. Mr. Smedberg received his civil engineering degree from the University of Michigan and an L.L.B. degree from La Salle Extension University. He had served as city engineer for Muskegon Heights, Mich.; as superintendent of the water and sewer department of Greensboro, N. C.; and as city manager of Greensboro.

William L. Stanton (M. '32), age 63, retired engineer, died recently in Pasadena, Calif. A graduate of the University of Michigan, Mr. Stanton had taught at his alma mater, Texas Agricultural and Mechanical College, the University of Minnesota, and the University of Southern California. During the first World War, Mr. Stanton served in the Corps of Engineers. He had completed several assignments abroad with Stuart, James & Cook, and the Lockheed Corporation.

(Continued on page 118)

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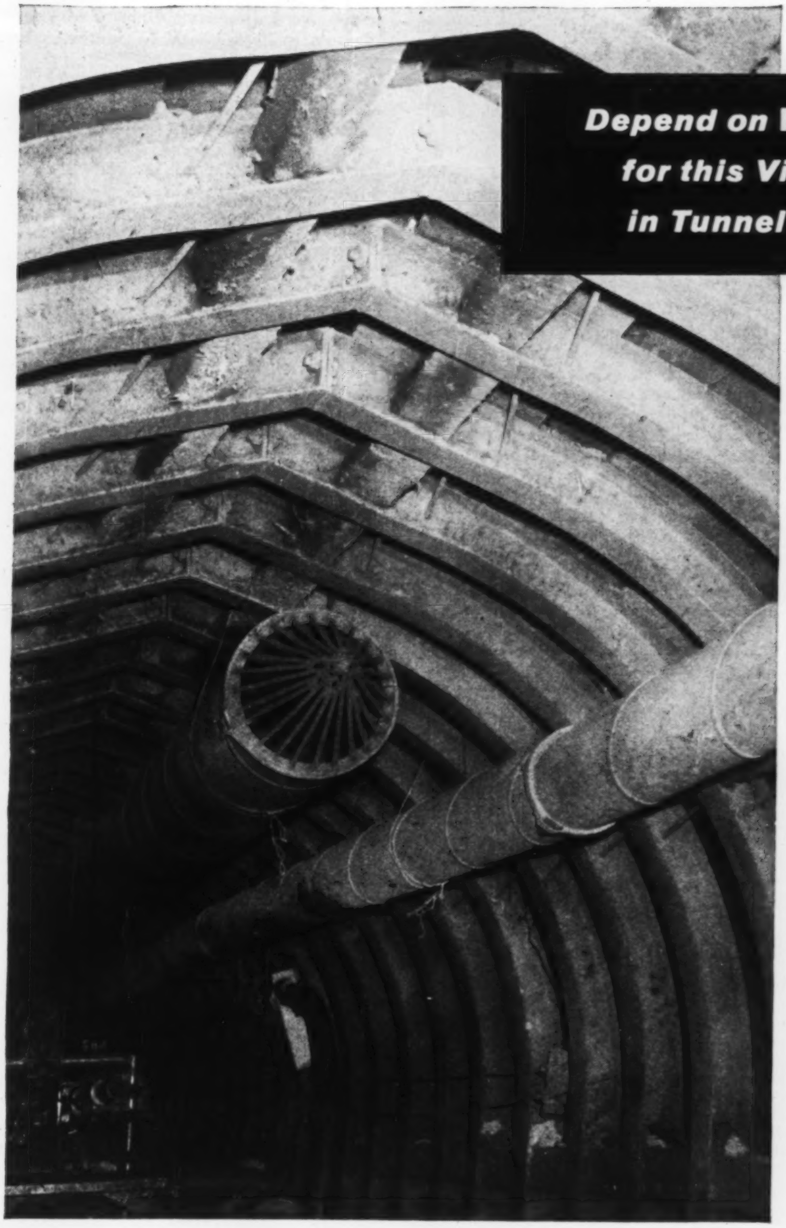

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Deceased

(Continued from page 116)

Paul L. Stuenkel (A.M. '43), age 56, senior engineer of bridge design with the Kansas State Highway Commission, died recently in Topeka, Kans. Mr. Stuenkel, who was a civil engineering graduate of Kansas State College, had served in the Highway Commission for over 20 years.

William L. Sylvester (A.M. '30), age 64, consulting engineer with Gee and Jensen in West Palm Beach, Fla., died there on February 5. Mr. Sylvester had a record of over 35 years on public works. He had served as project engineer with Greeley and Hansen, Chicago consultants on sewage and water supply. For 16 years, Mr. Sylvester worked with the New York City Department of Public Works as engineer assistant to the Commissioner and more recently as director of public relations. He had also been assistant chief engineer of sewage treatment for the city.

Julian H. Torras, Jr., (J.M. '51), age 32, construction engineer for the Corps of Engineers in Fort Worth, Tex., died in Del Rio, Tex., on April 4. Mr. Torras was graduated from the Agricultural and Mechanical College of Texas with a civil engineering degree. Joining the Corps of Engineers immediately after his graduation, he served it as a project engineer, office engineer, and construction engineer.

Frederick C. Waddell (M. '36), age 72, retired structural engineer for the Bethlehem Steel Company, died in Bethlehem, Pa., on April 14. Mr. Waddell, a native of Nova Scotia, received his B.S. degree from the Massachusetts Institute of Technology. He had held the post of chief engineer for the Hay Foundry and Iron Works until the company was taken over by Bethlehem Steel, which he served in many capacities until his retirement in 1955.

Kirby C. Weedin (M. '10), age 90, for many years engineer and superintendent of the Foundation Company of Canada, Ltd., died in Montreal recently. Born and educated in Missouri, Mr. Weedin spent the early part of his engineering career with several firms in New York, Idaho, Canada and China. In 1925 he joined the Foundation Company as construction superintendent.

George F. Wieghardt (M. '20), age 71, chief engineer for the Hackensack (N. J.) Water Company, died in West Englewood, N. J., on January 9. Mr. Wieghardt, a civil engineering graduate of Cornell University, had been design engineer with the New York Power Construction Company and had spent several years with the Baltimore City Water Department before joining the Hackensack Water Company. He was with the company in responsible positions for more than 25 years.

George M. Wilson (J.M. '55), age 24, hydraulic engineer with the U. S. Geological Survey in Albany, N. Y., was killed recently in a street accident in Yonkers, N. Y. A civil engineering graduate of Rensselaer Polytechnic Institute, Mr. Wilson joined the Survey immediately after his graduation.

Eugene A. Yates (M. '25), age 77, chairman of the board of the Commonwealth and Southern Corporation, New York City, died there recently. Mr. Yates received his B.S. degree from Rutgers University. He was with Fraser, Brace and Company, General Contractors, as superintendent of construction, then with the Alabama Power Company as chief engineer. In New York, Mr. Yates was engaged in consulting engineering, specializing in hydroelectric work. Since 1935 he had been with the Commonwealth and Southern Corporation.

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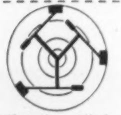

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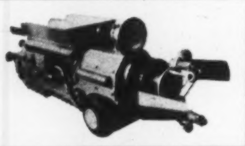

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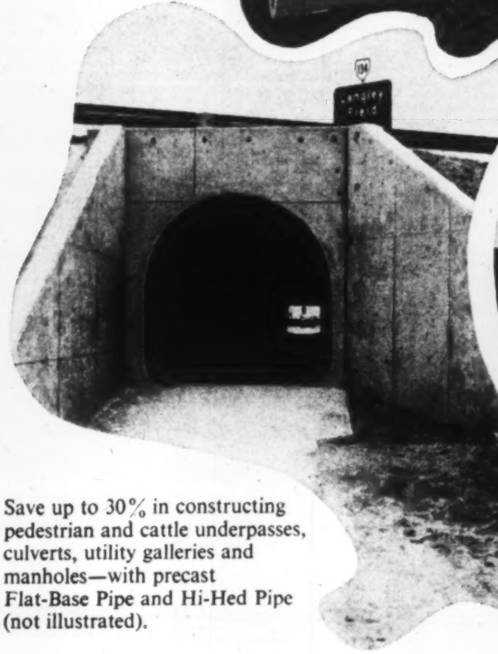

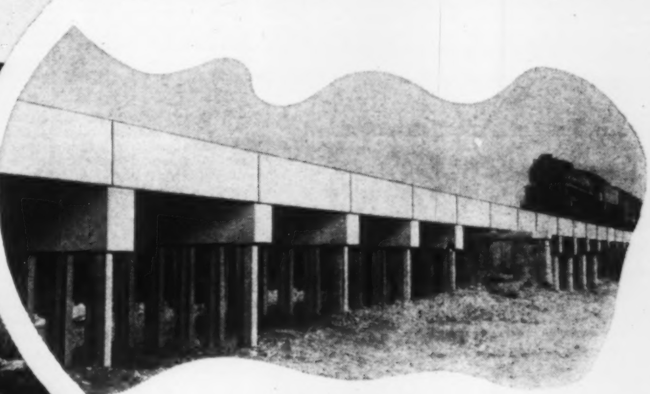

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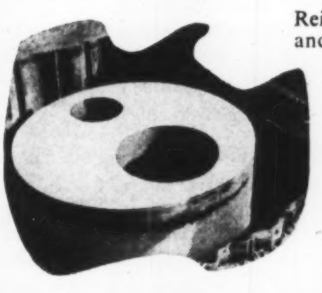

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This placement service is available so members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

Field/Office Engineer, J.M., ASCE, B.C.E., 30, five years' extensive experience land surveying including subdivision computations and layout, title surveys, etc. Overseas construction, six years' all phases including construction supervision, field and office layout. Location desired, Northeast. C-338.

Field Engineer, J.M., ASCE, B.S., 27, office engineer of a $3,000,000 re-development project. Two years' experience in drainage, paving, grading, surveying and other forms of highway construction. Location desired, Long Island, N. Y. C-339.

Civil Engineer, M. ASCE, B.S. in C.E., 54. Registered Maryland and Washington, D.C., retiring, 30 years' diversified government service: *(a)* Corps of Engineers on R & H improvements and flood control projects and *(b)* Department Air Force, including four years' duty (Lt. Colonel) as installations engineer and staff office, various phases of planning, construction, and maintenance military bases. Desires administrative, managerial position involving reports, correspondence technical writing. Location desired, metropolitan Washington, D.C. area. C-340.

Civil Engineer, A.M., ASCE, B.S.C.E., P.E., 47, varied experience in office and field on highways, bridges, and buildings. Predominate experience in structural design and specification writing for office and public type buildings. Desire connection with company planning expansion as a project engineer or with a contractor-engineering firm. Location desired, Midwest or East. C-341.

Sanitary Engineer, M. ASCE, B.S.C.E., A.S.E.E., P.E. Diploma, American Sanitary Engineer, M.S. Twenty years' experience including sales engineering, teaching, water plant operation, consulting; work involved engineering, technical and administrative supervision, and report writing. Will consider administration of municipal water supply, teaching, or engineering school administration. C-342.

Civil Engineer, J.M. ASCE, B.S.C.E., M.S.C.E. (Structures), 32, nine years' domestic and foreign experience; teaching, design, construction and maintenance of railroads, highways, chemical and oil plants; registered. C-343.

Soils And Materials Engineer, A.M. ASCE, 39, single, highly qualified, over eight years' office and field. M.S. (soil mechanics) and M.S. (highway engineering); special experience in soils and foundations. Registered P.E., Illinois and Pennsylvania. Location desired open. C-344.

Civil Engineer, J.M. ASCE, B.S.C.E., 28, six months' structural design; four years' electronics and general civil engineering; two years' site development, drainage, soils, pavements, and specifications. Location desired, Midwest. C-345-9533-Detroit.

Executive Position, 53. Experience in varied engineering and construction fields including large office and industrial buildings, parks, etc. Last ten years' managing operations of large U. S. construction firm in San Francisco. Seeks executive position, supervisory of large scale construction projects. Headquarters, U. S. S-1286.

Construction Engineer, A.M. ASCE, B.C.E., 36; registered C.E., California. Nine years' construction on commercial buildings in all types heavy industry, serving as owners representative or contractors engineer. Responsible for all phases of construction, two years' design and estimating on commercial and industrial construction. Desires responsible position in Southern California. C-346-San Francisco.

Positions Available

Project Design Engineer, graduate civil with extensive experience in structural steel and reinforced concrete design for industrial building. Salary, $10,000-$12,000 a year. Location, New York, N. Y. W-5911.

Instructor, civil, to handle statics, dynamics, strength of materials. Salary open. Location, Pennsylvania. W-5958.

Director of Engineering, to correlate, program and direct the engineering design service, to provide sound engineering design at reasonable cost for large engineering architectural consulting organization. Should be a licensed Professional Engineer, preferably but not necessarily structural. Heavy administrative as well as technical experience working with architects on major commercial and industrial buildings. Salary, $14,000-$18,000 a year, plus profit-sharing plan and top fringe benefit program. Location, California. W-5984.

Associate And Assistant Professors And Instructors for department of civil engineering; M.S. degrees desirable but instructors working toward advanced degree will be considered. *(a)* Courses in civil engineering; *(b)* Courses in engineering mechanics; *(c)* Instructor in engineering drawing, descriptive geometry and surveying. Salaries based on experience and education. Available September 1958. Location, Midwest. W-6030.

Highway Engineers for asphalt road construction projects. *(a)* supervisory field construction engineer with twenty years' experience; *(b)* resident engineer with ten years' experience; *(c)* specification writers and estimators with ten years' experience. Salaries open. Two-year contracts. Location, Middle East. F-6062.

Teaching Personnel, *(a)* associate professor to teach thermodynamics-fluid mechanics, heat transfer and expand research program. Ph.D. preferred. Salary, to $10,000 for nine months. *(b)* chairman, civil engineering department, Ph.D. preferred. Will be responsible for structures sequence. Salary, to $10,000 for nine months. Location, California. W-6077.

Civil Engineer, either a recent graduate, or with up to five years' experience, for office and field work with a consulting engineer. Salary good; opportunity for advancement. Location, upstate New York. W-6086.

Sanitary Engineer, B.S. or M.S. in civil or chemical engineering; professional license desirable but not demanded. Must have design experience covering municipal sewage and/or water treatment plants. Some estimating experience helpful. For staff of engineering and consulting firm. Salary, $9,000-$12,000 a year. Company pays placement fee. Location, Midwest. W-6090.

Instructors, graduate civil engineers. *(a)* One to teach in fluid mechanics field. *(b)* One to teach in the structural and soils mechanics field. Will consider engineers with two or three years' ex-

(Continued on page 121)

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$597 to $776 a month, including annual automatic and longevity salary increases. Starting salary may be at any step in basic range ($597 to $712) depending upon qualifications. Interview and moving expenses paid by city. U. S. citizenship required, but no residence restrictions for man to begin work. Registration as a professional engineer required. Wisconsin Retirement Fund and Social Security Benefits.

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Established organization with excellent reputation has opening for structural engineer in Kansas City area to consult with engineers, architects, contractors on structural design and construction. Applicant must have initiative for personal contacts.

Applicant should be registered, graduate engineer, qualified in structural design with ability to present ideas to others. Construction knowledge desirable. Excellent working conditions. Starting salary commensurate with qualifications.

Please submit details and qualifications in full and enclose photograph. Confidence fully respected.

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TECHNICAL EDITOR

Civil engineering graduate, in his twenties, wanted for position as assistant technical editor. Some experience is desirable but can be weighed against other important attributes such as innate ability to recognize good English and to deal diplomatically with fellow engineers and authors.

Recent graduates and discharged servicemen with exceptionally good references will be considered. Beginning salary is dependent on qualifications. Liberal vacation, sick leave, hospitalization, and retirement plans.

Box 288

Civil Engineering
33 West 39th Street
New York 18, New York

ESPS

(Continued from page 120)

perience who would like to continue with graduate studies or more experienced engineers without teaching experience. Salaries open depending on qualifications. Will negotiate placement fee. Location, New York, N. Y. W-6107.

Civil Engineer, registered in state of Florida, with municipal engineering; must be capable administrator with engineering background; able to expedite projects and building programs; well acquainted with storm drainage, sewerage, streets, etc. Location, Florida. W-6110.

Highway Engineers with a minimum of three years' experience. Excellent opportunity with established consulting engineering firm. Location, Midwest. W-6117.

Resident Engineer, civil graduate, with at least ten years' municipal engineering experience including sewage disposal construction. Salary, $8,000-$10,000 a year. Location, New Jersey. W-6131.

Structural Engineer, civil graduate, 30-35, with design and construction experience on concrete and steel buildings, to supervise warehouse project. Must speak Spanish and have Latin American experience. Salary, $10,000 a year. Location, Mexico. F-6132.

Structural Design Engineer, to head up a department in the design of industrial and institutional type buildings. Should be well versed in application of design as related to both structural steel and reinforced concrete, etc., and should have a knowledge of foundation design. Salary, about $9,000 a year. Location, Virginia. W-6136.

Highway Designers with considerable experience, some time of which has been spent in a consulting engineer's office. Also need highway and bridge draftsmen. Location, New England. W-6141.

Civil Engineer, ambitious engineer wanted for assistant and ultimate partner in fastest growing area in Washington. Future only limited to amount of energy and capital that is invested. Owner, MIT graduate—C.E.C. USNR (Ret.), wants congenial associate, will facilitate arrangements. Good living in biggest sports and game country. W-6143.

Resident Engineer, canal and waterways, graduate engineer, 40 to 60; ten or more years in construction of canals and waterways. Duties will include general supervision of construction on canals and waterways. Will supervise work of several U. S. engineers and Japanese inspectors for consultant. Salary, $14,000-$16,000 a year. Employer will negotiate placement fee. Location, Japan. C-6827.

Civil Engineer-Harbor Engineering, supervisory, planning and design duties. California registration, three years' broad professional experience including survey, design and construction. Salary, $10,000-$11,000 a year. Location, California. S-3538.

Positions Announced

U. S. Civil Service Commission. Examinations are being given for city planners in various Federal agencies in Washington, D. C., and throughout the United States. Basic requirements are four years in accredited college or university in related subjects and four years of technical experience. For the grades, GS-9 through GS-15, there are varying other requirements. Form 57, Card Form 5001-ABC, and Standard Form 15 must be submitted. Forms are available at local civil service offices and at U. S. Civil Service Commission, Washington 25, D. C.

U. S. Navy. Civil Engineer, GS-9, wanted on Guam for structural project review. Apply to Naval Overseas Employment Office (Pacific), Section A, 45 Hyde St., San Francisco 2, Calif. Vacancy exists for Civil Engineer, GS-9, Mare Island Naval Shipyard. Submit Form 57 to Employment Superintendent, Code 172, Vallejo, Calif.

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Prefer several years' experience in any of these fields:

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Will consider lesser experience with good educational background. Several recent graduates will be added to our structural staffs to round out this planned expansion program. Occasional openings for combination men in construction supervision and inspection; must be free to move and to assume office duties between assignments.

Sverdrup & Parcel, Inc., are professional engineers engaged primarily in design work covering a wide scope of practice. The variety and unusual character of our work, including as an example the proposed world's largest bridge project, offer excellent opportunities for individual and professional development and advancement.

We need a large number of men for our general offices in St. Louis and several for our branch office in San Francisco. These are permanent additions to our regular staffs. Confidential interview can also be obtained at Washington, D. C., and Portland, Oregon.

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CIVIL ENGINEERS

Vacancy due to a promotion in Madison, Wis. Graduate engineer with some experience to begin in Engineering Dept. at about $455 a month, **unless** special arrangements can be made for a higher entrance salary due to qualifications. Annual and longevity increases to $572. Office and field work in design and construction of sewer, water, street, sidewalk and curbs. Possession of Engineer-in-Training Certificate required. No residence restrictions for U. S. citizen to begin work. Wisconsin Retirement Fund and Social Security benefits.

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Not less than 15 years experience in bridge design and detail.

Squad boss experience preferred.

Paid sick leave and vacation.

Attractive pension plan.

Apply by letter giving education and experience.

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Room 600
320 North Clark Street

News of Engineers

(Continued from page 23)

After a career of 40 years with the U. S. Geological Survey, **Henry C. Beckman** has retired as division hydrologist of the Water Resources Division. For the past year, Mr. Beckman has served in the Mid-Continent Area of the Division, which includes 17 states. Mr. Beckman will continue to serve the Survey on a part-time basis as a special assistant and adviser, and also to be available for part-time outside work as a consulting hydrologist.

H. C. Beckman

A number of ASCE members were among recent Navy Civil Engineer Corps assignments and transfers. They are **Rear Adm. A. J. Fay,** district civil engineer and district public works officer, Fifth Naval District, Norfolk, Va.; **Rear Adm. M. W. Kehart,** inspector general, BuDocks, Washington 25, D. C.; **Rear Adm. William Sihler,** director, Atlantic Division, BuDocks, New York, N. Y.; **Capt. R. B. Atkins,** officer in charge of construction, BuDock Contracts, APO 285, New York, N. Y. (Madrid, Spain); **Capt. J. K. Batchelor,** officer in charge of construction, BuDocks Contracts, Navy No. 121, New York, N. Y. (Balboa, Canal Zone); **Capt. E. R. Bennett,** commanding officer, Public Works Center, Naval Base, Newport, R. I.; **Capt. W. C. G. Church,** district public works officer, Sixth Naval District, Charleston, S. C.; **Capt. L. C. Coxe,** assistant chief for planning and design, BuDocks, Washington 25, D. C.; **Capt. J. G. Dodd,** district public works officer, Third Naval District, New York, N. Y.; **Capt. J. W. Gordanier,** Industrial College of the Armed Forces, 4th and P Streets, N.W., Washington 25, D. C.; **Capt. J. A. White,** public works officer, U. S. Naval Air Station, Navy No. 537, FPO, New York, N. Y.; **Comdr. J. C. Castanes,** Bureau of Ordnance, Department of the Navy, Washington 25, D. C.; **Comdr. D. K. Culp,** resident officer in charge of construction, BuDocks Contracts, Bemoore, Calif.; **Lt. Comdr. M. H. Allen,** Public Works Center, Naval Base, Newport, R. I.; **Lt. Comdr. J. J. Reeve, Jr.,** commanding officer, U. S. Naval Air Station, Navy No. 537, New York, N. Y.; **Lt. W. H. Anderson,** Naval Retraining Command, Camp Elliott, San Diego, Calif.; and **Lt. (jg) A. R. Socha,** assistant resident officer in charge of construction, Mare Island Naval Shipyard, Vallejo, Calif.

Parsons, Brinckerhoff, Hall and Macdonald, New York City engineering firm, announce the relocation of their New York office to 165 Broadway, New York 6, N. Y. The office was originally at 51 Broadway.

M. R. Golly has joined Smith and Loveless, Inc., water and sewage equipment company at Lenexa, Kans., as chief sanitary engineer. Mr. Golly will be in charge of new development work in extending the company's line of sewage treatment equipment. Before joining Smith and Loveless, Mr. Golly served for 20 years with the Kansas State Board of Health.

Arthur W. Harrington, district engineer with the U. S. Geological Survey, Branch of Surface Water at Albany, N. Y., will retire the end of this month after more than 42 years of service with the federal government. Mr. Harrington joined the Survey in 1914 and has held the post of district engineer since 1922. He is a former Vice-President and Director of ASCE and has been active in the Mohawk-Hudson Section.

A. W. Harrington

F. E. Wisely has joined Horner and Shifrin, consulting engineers in St. Louis, Mo., as an associate. Mr. Wisely has had a broad background in industrial engineering. He designed many industrial buildings and units during his connections with Western Cartridge Company and the Monsanto Chemical Company.

Michael Baker, Jr., of Rochester, Pa., is the recipient of one of Pennsylvania State University's Distinguished Alumnus Awards. The award is given annually at commencement time to former students of the university who through their personal and professional lives have contributed to their communities. The award goes to Mr. Baker in recognition of his having "singlehandedly" built up a large international consulting engineering organization, Michael Baker, Jr., Incorporated.

Herbert H. Boyd has retired as construction management engineer for the Navy Bureau of Yards and Docks at the Westinghouse jet engine plant in Kansas City, Mo. Mr. Boyd went to the aviation engine plant for the Reconstruction Finance Corporation in 1943, shortly after construction of the facility was started. He remained at the Westinghouse plant as a civilian employee of the Navy when RFC activities ceased in 1948. Recently Mr. Boyd was commended by the Navy for his intimate knowledge of design, construction and maintenance of industrial buildings and utilities.

H. H. Boyd

New in Education

Curricula Addenda . . . Ignoring the fact that the good old summer time is traditionally vacation-time, engineering schools all over the country are offering a wide variety of summer courses to ambitious engineers. There are refresher courses, special schools and seminars. Take your choice of hot-weather education from this list: On the Los Angeles campus of the **University of California,** the Institute of Transportation and Traffic, Engineering and University Extension is offering a one-week course in the Fundamentals of Traffic Engineering, from August 25-29. Details from Institute headquarters, c/o the University, Berkeley, Calif. . . . Also at the **University of California,** an integrated program in Strain Gage Techniques will be offered August 18-29. The course will combine lectures and laboratory work. Applicants must have a B.S., or technical experience equivalent, in engineering, physics, or metallurgy, and information is available from Engineering Extension, University of California, Los Angeles 24, Calif. . . . In a repeat of previous courses, the **Georgia Institute of Technology** and the **University of Arkansas** are offering a Fourth Annual Institute on Urban Planning from August 18-29 on the Arkansas campus. There will be a basic two-week seminar and a special advanced seminar from August 25-29. Information from the University of Arkansas, Fayetteville, Ark. . . . **The Massachusetts Institute of Technology** is adding another attraction to its already busy summer schedule. A special program in Cavitation Mechanics in Engineering Practice will feature a series of lectures and demonstration from July 8-18. Information from the Office of Summer Session, Room 7-103, MIT, Cambridge 39, Mass. . . . Sponsored by the **Institute of Traffic Engineers,** the second in a series of seminars will be held in Sacramento, Calif., June 16-18. The seminar will deal with traffic operations on freeways and expressways. Information may be obtained from the Institute of Traffic Engineers, 2029 K St., N.W., Washington, D. C. . . . Of special interest to highway engineers will be the two-week course entitled "Introduction to Computer Methods in Highway and Traffic Engineering," July 7-19. Under the sponsorship of the Bureau of Highway Traffic at **Yale University** and the Institute of Transportation and Traffic Engineering at the **University of California,** the program will take place on the Yale campus. Information from Director, Bureau of Highway Traffic, Strathcona Hall, Yale, New Haven, Conn.

N.Y.U. Research . . . New York University's total research expenditures rose from $2,865,700 to $3,055,400 within the past year. The research, which dealt mainly with public health problems and sanitation, had a staff of 455 faculty members at work. Joining the faculty members were research engineers, me-

(Continued on page 124)

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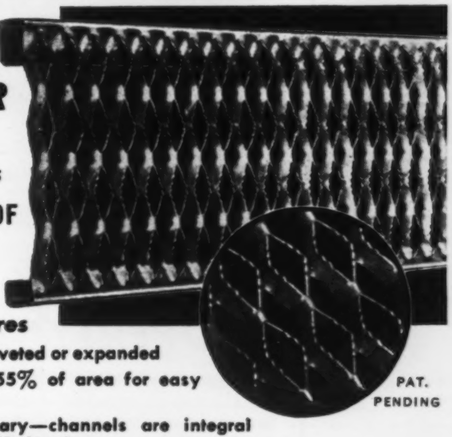

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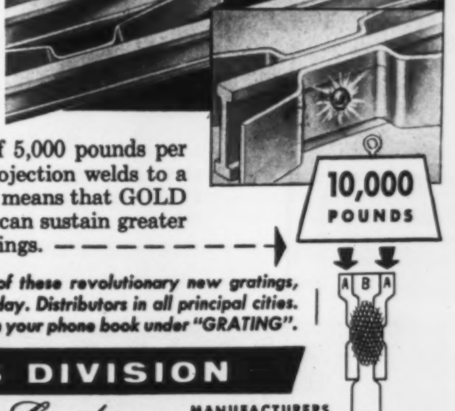

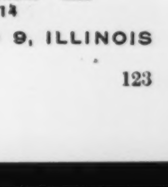

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New in Education

(Continued from page 123)

teorologists, nuclear engineers, physical therapists, solar energy scientists, and representatives from many other engineering and scientific fields.

Graduate Work. . . . A graduate program in engineering mechanics is being offered at the College of Engineering of the *University of Florida*. This course will emphasize professional training as opposed to specialization and will lead toward a Ph.D. degree. . . . With a grant from the Community Air Pollution Program, the *University of North Carolina* announces the implementation of its course in air pollution. The course offers a master's degree and is open to sanitary scientists and engineers.

College Construction. . . . Spring is marked this year by the beginning of several new college construction projects. *City College of New York* will begin work on a $8 million School of Technology Building. The building will enable the college to increase its engineering enrollment by 38 percent over the next seven years. . . . *Georgia Institute of Technology* has broken ground for a new $600,000 Radioisotopes and Bioengineering Building which will provide facilities for graduate students and staff members to engage in research in this field.

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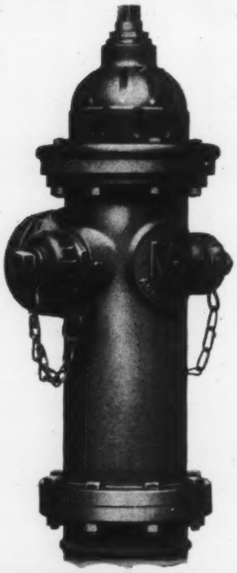

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SUBSIDIARY OF WALWORTH

Non—ASCE Meetings

American Institute of Architects. Annual convention at the Hotel Cleveland, Cleveland, Ohio, July 7-11. For details write the Institute, 1735 New York Ave., N.W., Washington 6, D. C.

American Institute of Chemical Engineers. Golden Jubilee Celebration, Philadelphia, Pa., June 22-27. Information from J. I. Savoca, Socony Mobil Oil Co., Paulsboro, N. J.

American Institute of Electrical Engineers. Summer General Meeting and Air Transportation Conference, at the Hotel Statler Hilton in Buffalo, N. Y., June 22-27. Details from AIEE, 33 West 39th St., New York 18, N. Y.

American Society for Engineering Education. Annual meeting at the University of California, June 16-20. Information from Prof. Leighton Collins, University of Illinois, Urbana, Ill.

American Society for Testing Materials. Annual meeting at the Hotels Statler and Sheraton-Plaza, Boston, Mass., June 22-27. Information from ASTM, 1910 Race St., Philadelphia 3, Pa.

Atoms for Peace. International Conference on Peaceful Uses of Atomic Energy, Geneva, Switzerland, September 1-13. Details from headquarters in Geneva.

Atomic Energy Commission. Fifth International Electronic and Nuclear Energy Exposition in Rome, Italy, June 16-30. Details from John Vinciguerra, Assistant Manager, AEC Savannah River Operations Office, Aiken, S. C.

Instrument Society of America. Automation Conference and Exhibit, Philadelphia, Pa., September 15-19. Details from Fred J. Tabery, Conference and Exhibit Manager, 3443 South Hill St., Los Angeles, Calif.

National Council of State Boards of Engineering Examiners. Annual meeting in Milwaukee, Wis., August 20-22.

National Society of Professional Engineers. Annual meeting, Chase-Park Plaza Hotels, St. Louis, Mo., June 11-14.

Royal Society of Flemish Engineers. Third International Congress of Port Techniques, June 15-21 in Antwerp, Belgium. Inquiries to the Society, Torengebouw VIII, 31 Schoenmarkt, Antwerp, Belgium.

U. S. Committee on Large Dams. Sixth International Congress on Large Dams, New York City, at the Hotel Statler, September 15-20. For information write the U. S. Committee on Large Dams, Engineers Joint Council, 29 West 39th St., New York 18, N. Y.

RECENT BOOKS

(Added to the Engineering Societies Library)

Building Construction Handbook

The handbook gives information ranging from the selection of an architect through all stages of construction and construction management. It begins with a section on the relationship of owners, architects, consulting engineers, and contractors, and continues with properties of building materials, stress analysis, structural design, building components, and construction practices. Sections on estimating construction costs, construction management, specifications, insurance and bonds, conclude the volume, edited by Frederick S. Merritt. (1958, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y. Various pagings, $15.00.)

Design Of Tilt-Up Buildings

F. Thomas Collins provides the fundamental information necessary to good design practice for job site prefabrication. Gives data on lateral force resistance, roof framing, columns, wall panels, pick up analysis, concrete floor slabs, footings and foundations, and joinery. (1957, Know-How Publications, P.O. Box #208, San Gabriel, Calif. 162 pp., $12.50.)

Drainage Of Agricultural Lands

The methods and means used to drain land are studied in relation to water tables, movement of water through soil, and the relationships that exist between water tables and crops. Aspects dealt with include the physics and engineering aspects of land drainage, drainage investigation methods, and land drainage in relation to soil and crops. James N. Luthin includes 32 pages of references at the end of his book. (1957, American Society of Agronomy, 2702 Monroe Street, Madison 5, Wis. 620 pp., $11.00.)

Engineering Hydrology

Stanley S. Butler provides a concise treatment of the subject, emphasizing the quantitative approach, with illustrations of applications and of the types of data involved. Although the central subject is runoff—both surface and ground-water—other hydrologic topics are shown to be essential factors: precipitation, evaporation, transpiration, drainage-basin characteristics, etc. The author's aim is to provide a practical and unified approach to the subject. (1957, Prentice-Hall, Inc., Englewood Cliffs, N. J. 356 pp., $7.00.)

Engineering Surveys: Elementary And Applied

Second Edition

A revision of a text by Harry Rubey and others, contains in addition to the basic elements, units on horizontal and vertical control, photogrammetry, hydrographic surveying and flow measurements, legal principles of boundary surveying, engineering astronomy, and underground surveys. Two new sections are included on modern instruments and on measurements and errors. Appendices and tables are paged separately from the main text. (1958, The Macmillan Company, 60 Fifth Avenue, New York 11, N.Y. 728 pp., $6.75.)

Hydroelectric Engineering Practice

This is an extensive study of modern British and Continental hydroelectric engineering. The first volume covers preliminary hydraulic considerations and the overall design and construction of civil engineering works. The second studies water turbines, generating plants, control and transmission equipment, and power station planning. Economic considerations, operation and management, and maintenance are dealt with in the third and final volume. Fine illustrations, excellent typography, chapter bibliographies, and indexes to each volume add to the reference value of the work, edited by J. Guthrie Brown. (1958, Blackie and Son, Ltd., Glasgow, Scotland. 3 volumes, 19 guineas.)

International Association For Bridge And Structural Engineering, Fifth Congress, 1956

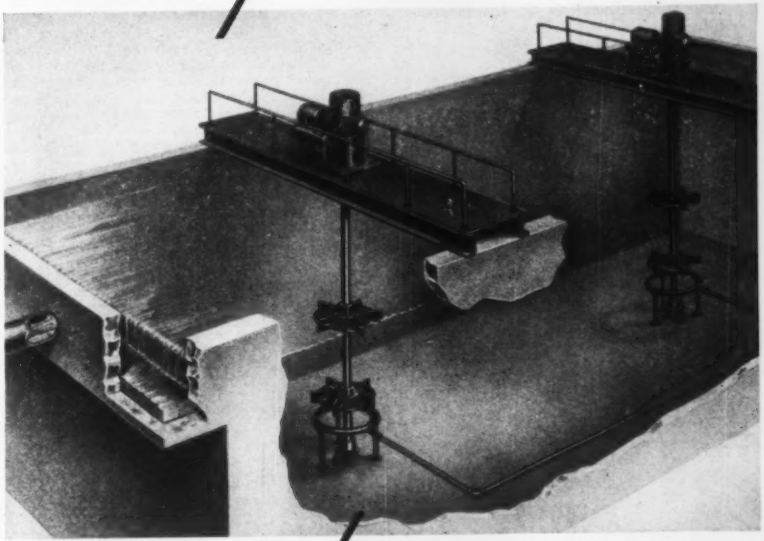
The congress devoted one working session each to six major themes; the papers here published are consequently grouped in each volume into these same divisions: loading and strength of bridges and structures; slabs and various curved structures in reinforced concrete; welded steel structures; structures in steel and light alloys; special problems of reinforced and prestressed concrete; reinforced and prestressed concrete practice. As is customary with the proceedings of these important congresses summaries of all papers are given in English, German, French, and the language of the country in which the congress is held. (Published 1957 by the Portuguese Group of the Association, Lisbon, Portugal. 2 volumes, 550 escudos.)

An Introduction To Automatic Computers

This is intended to convey the computer's functions from a business system's point of view, with its uses and limitations. Ned Chapin discusses major analysis techniques, with reference to applications, programming and operation. Many specific examples are included for purposes of illustration. Appendices provide extremely detailed data on automatic computers commercially

(Continued on page 126)

IT'S NEW / It's from DORR-OLIVER



THE D-O AERATOR /
- increases oxygen absorption
- reduces sludge clogging
- cuts plant costs

Higher effective oxygen utilization—up to 50% compared with 5 to 6% in conventional systems—enables the new D-O Aerator to meet increased demands of the more concentrated activated sludges in today's biological sewage processes.

It's a brand-new design, proved by extensive pilot and operating plant work. Basic elements are high efficiency turbine type impellers and sparge rings for introducing air under the lower impeller. The sparge ring design virtually eliminates problems associated with conventional diffusion type equipment. Turbine aeration does not depend on constriction to produce small bubble size. There is less possibility of clogging, dead areas and short circuiting of sewage in the event of high entrance velocities.

What's more, overall installed costs are lower than those of conventional units. The new D-O Aerator can be adapted to a variety of tank sizes and installed in existing tanks. For more information write to Dorr-Oliver Incorporated, Stamford, Conn.

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Recent Books

(Continued from page 125)

available, including information on the arithmetic and logic unit, the storage unit, and input-output equipment. (1957, D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J. 525 pp., $8.75.)

Municipal And Rural Sanitation

Fifth Edition

This newly revised edition of a standard text, by Victor M. Ehlers and E. W. Steel, contains new material on institutional sanitation, federal aid available on housing and industrial hygiene developments. Up-to-date methods and concepts in rodent and insect vector control, new formulations on disinfectants and insecticides, equipment and methods for the collection and disposal of municipal refuse as well as other aspects of sanitary engineering are given full treatment. (1958, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y. 596 pp., $9.00.)

Oral Communication Of Technical Information

Robert S. Casey has provided a practical guide to effective speaking for technical personnel. The book covers organization of material, composition, delivery of formal and impromptu speeches, and the use of mechanical aids such as recordings and slides. In addition special sections are devoted to presiding at meetings, presenting science to the layman, and giving technical legal testimony. (1958, Reinhold Publishing Corp., 430 Park Avenue, New York 22, N.Y. 199 pp., $4.50.)

Register Of Dams In The United States

In anticipation of the holding of the next International Congress on Large Dams in the U.S., this extensive compilation has been prepared and edited by T. W. Mermel, presenting essential statistics on over 2,800 important dams in the U.S.—completed, under construction, and proposed. The main part of the book is an alphabetical listing of the dams, giving location, structural data, reservoir capacity, ownership, by whom the engineering was performed, and the construction contractors. Additional data consists of: a section containing photographs of over 300 dams; lists of the 100 highest and 100 largest dams, and of the 100 largest reservoirs; an alphabetical list of reservoir names; and a summary of the laws of all 48 states dealing with the supervision and control of dams. The book is sponsored by the United States Committee of the International Commission on Large Dams. (1958, McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N.Y. 429 pp., $12.50.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translations services, and can supply photoprint or microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

The Structures Of Eduardo Torroja

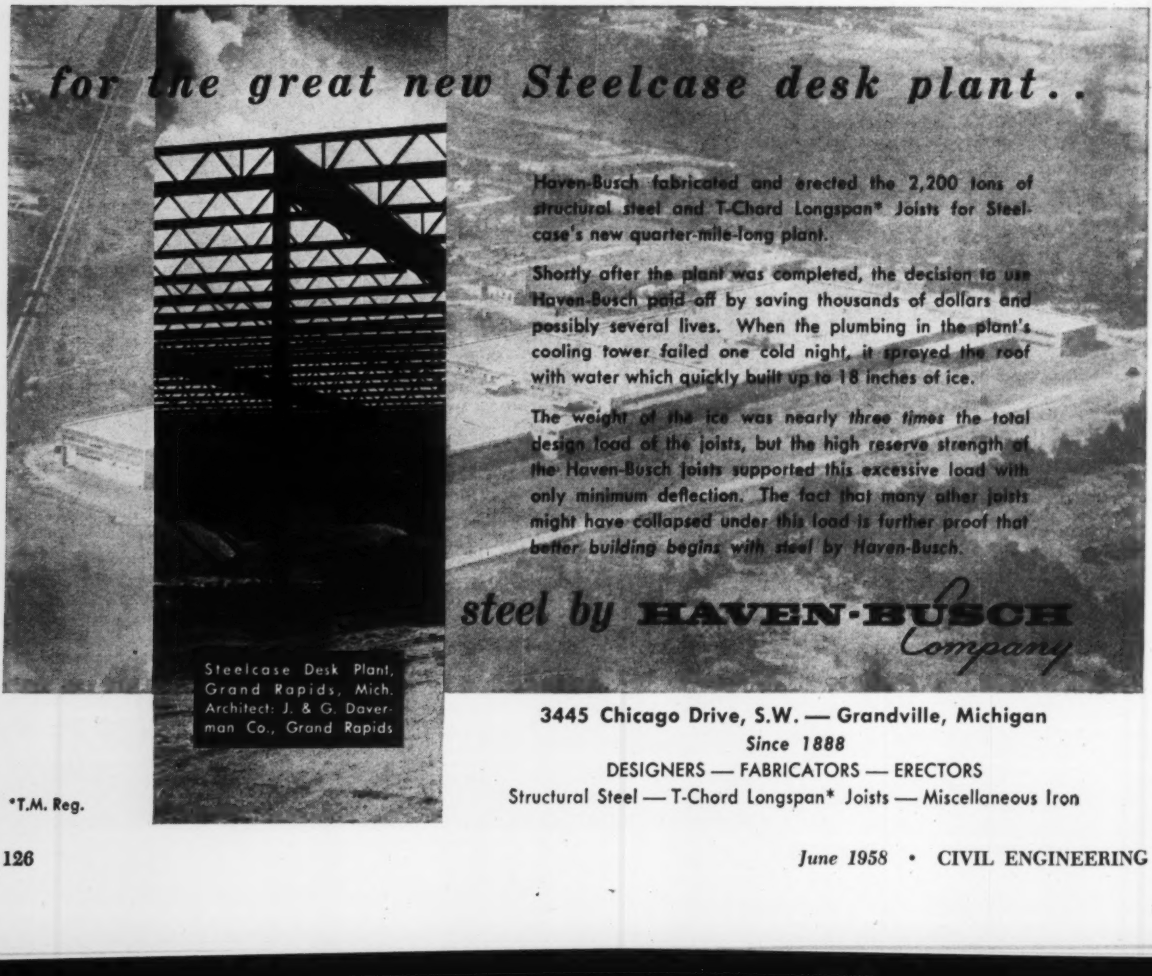
This book presents analyses of thirty structures designed by the Spanish architect-engineer. The book, by Eduardo Torroja, includes many types: bridges, churches, viaducts, stadia, water-towers, factories, dams and hangars. Many of these structures are of reinforced concrete, although wood, brick, and steel are used as well. One feature of the volume is the many fine illustrations, sketches and diagrams. (1958, F. W. Dodge Corporation, 119 West 40th Street, New York 18, N.Y. 198 pp., $8.50.)

The Theory Of Suspension Bridges

The book begins with an extended study of the behavior of a single cable under load and continues with an analysis of the various theories relating to suspension bridge problems. Following the Rankine theory, the elastic theory and its applications are studied as is the deflection theory and a Fourier series treatment of it. Alfred Pugsley concludes his book with a discussion of bridge oscillations. (1957, Edward Arnold Ltd., London, England; U.S. distributor, St. Martin's Press, 103 Park Avenue, New York 17, N.Y. 136 pp., $10.00.)

World Conference On Prestressed Concrete, Proceedings

A wide variety of papers, over 60 in all, deals with aspects of prestressed concrete, including materials and techniques; prestressed bridges and buildings; prestressed pavements, wharves, piles, dams, and masts; research and analysis; manufacture of precast prestressed concrete; and design and construction in various countries. The conference was presented by the University of California in 1957 in cooperation with the Prestressed Concrete Institute and other societies. (Published 1957 by the World Conference on Prestressed Concrete, Inc., Room 216, 417 Market Street, San Francisco, Calif. Various pagings, $10.00.)


for the great new Steelcase desk plant..
steel by HAVEN-BUSCH Company
Steelcase Desk Plant, Grand Rapids, Mich. Architect: J. & G. Daverman Co., Grand Rapids

Haven-Busch fabricated and erected the 2,200 tons of structural steel and T-Chord Longspan* Joists for Steelcase's new quarter-mile-long plant.

Shortly after the plant was completed, the decision to use Haven-Busch paid off by saving thousands of dollars and possibly several lives. When the plumbing in the plant's cooling tower failed one cold night, it sprayed the roof with water which quickly built up to 18 inches of ice.

The weight of the ice was nearly *three times* the total design load of the joists, but the high reserve strength of the Haven-Busch joists supported this excessive load with only minimum deflection. The fact that many other joists might have collapsed under this load is further proof that better building begins with steel by Haven-Busch.

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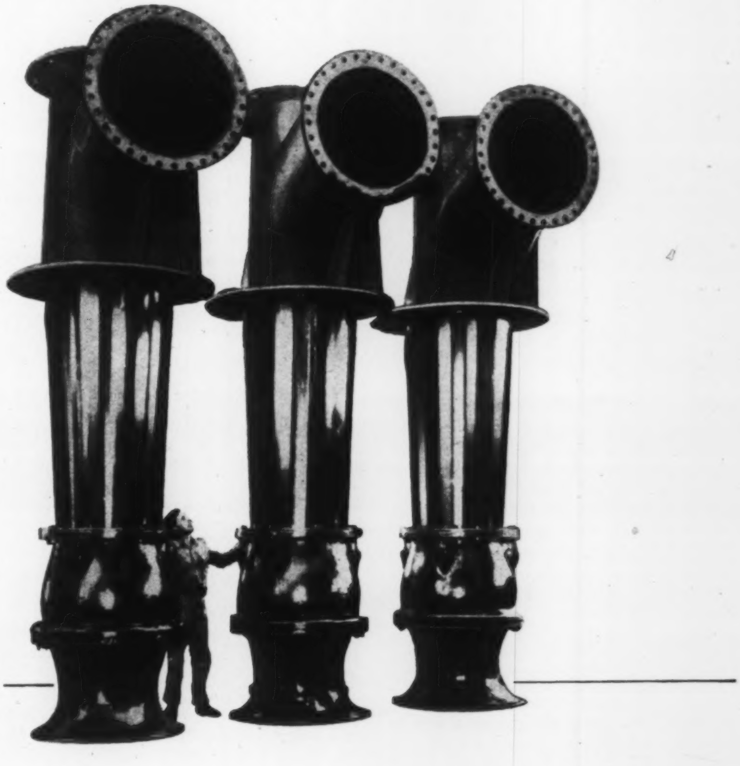

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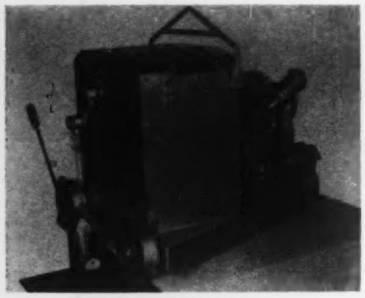
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Automatic Pin Puller

ONE OF THE BIGGEST headaches plaguing road construction men may disappear with the introduction of a new automatic pin pulling machine. The machine requires only one man to operate it and is considerably faster than conventional methods, pulling up to 1500 pins an hour without damage to forms or concrete. Weighing 565-lb and powered by a 3-hp engine, it is designed to pull any size pin with a maximum load strength of 3000-lb. Any damage to concrete is eliminated because the pulling load is on the forms. The pins themselves will have longer life because they come out vertically and without bending. Riding on rubber tires, the machine is easily moved from pin to pin, operates on either side without changes and can be operated forward or backward. **Cleveland Formgrader Company, CE-6, Avon, Ohio.**



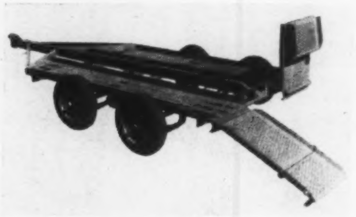
Finger Tip Controls

All-Purpose Roller

A NEW LOW COST ALL-Purpose Roller provides an inexpensive way to roll asphalt, paving and blacktop. It offers for the first time a Unitrol control system. A single operating level controls four functions: forward, reverse, throttle and brake. A special automatic transmission functions smoothly and provides instant response to the fingertip Unitrol control system. The new roller features a patented double lock brake that is applied automatically as the control lever is moved into neutral. Power for the one ton roller is supplied by a 4-hp gasoline engine with 6-1 gear reduction. Built for heavy duty, a rugged steel frame is mounted on drum type rollers which control desired operating weight by water filling. The forward guide roller is a split design for ease in turning and maneuverability. A tight turning radius and high curb clearance allows precision rollings close to building and obstructions. Speeds range from 0 to 1.8-MPH (forward and reverse). The gasoline engine and automatic transmission are housed beneath a hinged hood so that they are readily accessible for maintenance. **General Engines Company, Inc., CE-6, Route 130, Thorofare, N. J.**

Tractor Transport

MOVING A TRACTOR, BACK-HOE, front-end loader, fork lift or other light industrial equipment is easy, safe and fast with a Haulette tractor-transport. With the Haulette, equipment is hauled out to the job-site with a light pickup truck. No slow, tedious driving that's hard on equipment and wasteful of man-hours. All one has to do is set the brakes, lower the steel ramps and roll on the equipment. The exclusive easy-glide design and true-camber performance assures fast, easier towing and greater safety by eliminating sidesway. Heavy gauge welded construction, with exclusive Fayette undercarriage features, assures proper weight distribution and low center of gravity. Regardless of the size of tractor —and whether fully equipped with diggers, scoops, buckets or blades—there's a Haulette of the right size to handle the moving job perfectly. Lengths range from 14-ft to 20-ft overall, with bed lengths of 1[illegible]-ft to 15-ft 3½-in. Loading widths are from 70-in. to 95-in. Larger models have four wheels with 8:00 x 14.5, 12-ply tires, and electric brakes. **Haulette Division of Fayette Mfg. Co., CE-6, Morenci, Mich.**



Saves Time & Money

All-Steel Horizontal Shoring

PECCO BEAM, A NEW TYPE of all-steel horizontal shoring developed in West Germany, has been shown to reduce the cost of concrete slab formwork construction by from 15 to 30%. The telescoping beams adjust to span an area from 8-ft 6-in. to 27-ft 7-in. They need vertical support only at the two ends of the span, thus eliminating the forest of vertical shoring often required in standard construction methods. In buildings of steel beam construction, for example, the full span of the Pecco Beam can be utilized without a single vertical shore. The design has features that make it the most economical horizontal shoring equipment yet to be developed. The V-shaped beam, with a wide upper flange of 4¾-in., has great torsional strength for stability and safety, but is lighter in weight than rectangular-shaped beams and can be nested more compactly for shipment and storage. Another economy feature is the wedge lock that locks the lattice and plate sections at the required span with a single blow of a carpenter's hammer. No bolts, nuts or special tools are required and the placement of the lock assures a flat slab regardless of the width of the span. **Beatty Scaffold, Inc., CE-6, Tunnel Ave. and Beatty Rd., San Francisco, Calif.**

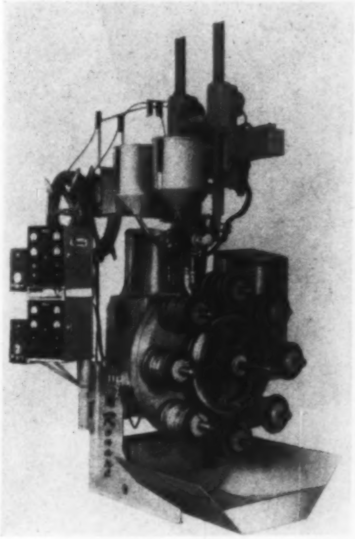
Aluminum Frameless Dump Trailer

THE NEW ALUMINUM frameless dump trailer is one ton lighter than steel frameless dump trailers of the same capacity. Therefore, it is capable of carrying an additional ton of permissible pay load. Built of $\frac{3}{16}$-in. high-strength aluminum alloy, it is available in a range of lengths from 14 to 24-ft, and capacities to meet buyers' specifications. The same strong aluminum alloy is used for the radius frame, suspension frame, body frame, and the wheels. Despite its light weight, the strength of this trailer is as great as that of normal steel construction. It is equipped with a single 8-in. Teleramic hydraulic telescope hoist with a 25-ton load rating. Since all lift power is applied directly to the front of the load, the hoist has greater leverage. Weight saved in both the body and the hoist, together with the absence of a trailer frame, make bigger permissible payloads possible. **Anthony Company, CE-6, Streator, Ill.**

Lightweight, But Strong

Welding Machine

A NEW TWIN HEAD AUTOMATIC Roller and Idler Welder and Positioner, capable of mounting eight tractor rollers and one idler at a time, has been announced. This welding machine builds up both sides of the worn tractor rollers simultaneously and automatically. By the time the first roller hard-faced reaches the eighth index position, it is sufficiently cooled to receive the second welding pass, thus enabling remarkable production. Only one spindle turns at a time, and rotates only when in the welding position. Only a few seconds of time required to rotate turret from one welding position to the next. Welding heads are not moved out of position for indexing operations. The twin welding heads operate simultaneously or independently as desired. The heads are power operated both vertically and horizontally by convenient controls, as well as the indexing of turret, and the tilting of the versatile positioner. Welding head carriage is equipped with motor drive. An automatic stepover is standard equipment to move each welding head with each revolution of the weldment to give an absolutely smooth surface over the entire weldment. **Sight Feed Generator Company, CE-6, West Alexandria, Ohio.**

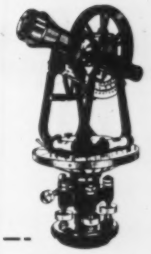


Rexarc MS-8

Electronic Moisture Meter

OF SPECIAL INTEREST TO ready mix companies and other users of sand and gravel, is a new improved model of the Electronic Moisture Meter. Through electric recording to an easily read indicating gauge which can be installed in any location, it measures the amount of surface moisture in any material dumped into a bin or hopper and indicates to the plant operator the surface moisture instantly and accurately. The machine is guaranteed accurate to less than 2/10ths of 1% on all types of sand regardless of mineral content. **C&W Sales Company, Inc., CE-6, 1490 Franks Lane, Menlo Park, Calif.**

Users Know: **NO TRANSITS HOLD ADJUSTMENT BETTER THAN**



Eagle TRANSITS

The reasons:

1. BEST MATERIALS

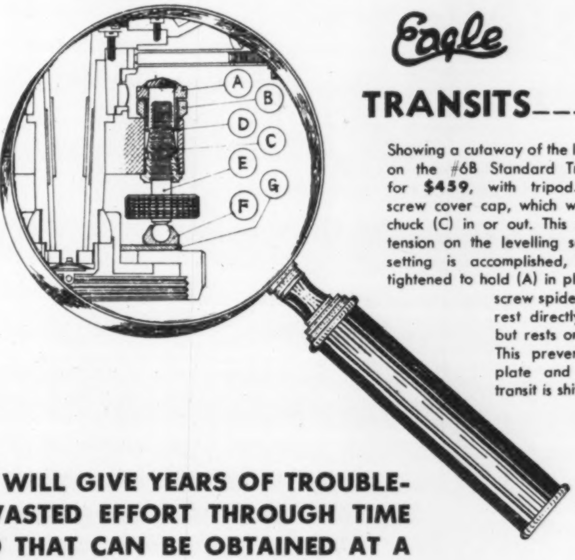
Made of special phosphor and bell metal bronzes produced in Canada, silver from Mexico, and world famous Hoya optical glass from Japan. Circle guard and dust baffle made from American aluminum.

2. VERY CLOSE TOLERANCE MACHINE WORK

Holds all parts in place during transportation and other abusive transactions. Lower paid skilled, foreign workmanship allows this careful and time consuming work to be done, while still keeping the price low enough to be practical.

3. BEST DESIGN

Taking advantage of best materials and the close tolerance machine work, EAGLE transits have been able to incorporate many refinements and intricacies that lesser instruments could not successfully use.



Showing a cutaway of the levelling screw assembly on the #6B Standard Transit, 6″ limb, selling for **$459**, with tripod. (A) is the levelling screw cover cap, which when turned pinches the chuck (C) in or out. This tightens or loosens the tension on the levelling screw (E). After proper setting is accomplished, the cap lock (B) is tightened to hold (A) in place. (D) is the levelling screw spider. The shoe (F) does not rest directly on the tripod plate, but rests on the sliding plate (G). This prevents damage to tripod plate and levelling screw when transit is shifted over a point.

Result: **A RUGGED TRANSIT THAT WILL GIVE YEARS OF TROUBLE-FREE PRECISION USE, SAVE WASTED EFFORT THROUGH TIME AND MOTION ECONOMY, AND THAT CAN BE OBTAINED AT A PRICE MUCH LOWER THAN ITS VALUE.**

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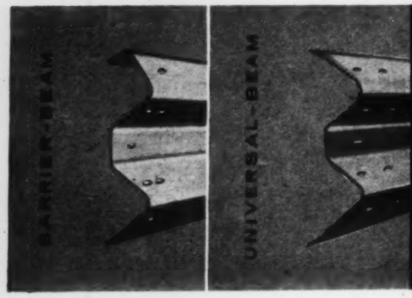

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Highway Guard Rail • Bridge Flooring
Steel Forms for Concrete Bridge Decks
Corrugated Metal Pipe • Window Wells
Metal Doors & Frames • Metal Buildings

EQUIPMENT MATERIALS and METHODS

(continued)

Magnetic Drive

WHITNEY-TORMAG MAGNETIC DRIVE is the name of a new product whose job is that of a safety go-between that is installed between motor and machine. It consists of just two rotors, one of them magnetic, and is designed to protect all kinds of equipment from the dangers of sudden, shock loaded starts and stops as well as equipment-wrecking starts and overloads. The rotors are mounted with an airgap between them. The bi-metallic rotor, which is designed to be the driving component, always rotates at motor speed. As the motor starts up, a controlled torque is induced in the magnetic rotor through eddy currents, with the permanent magnets supplying the necessary flux. Driving and driven rotors are never in contact—the airgap always exists between them—magnetic torque never wears out. **Whitney Chain Co., CE-6, Hartford, Conn.**

Work-Writing Arm

A NEW HEAVY DUTY EXTENDED work-writing arm which can support loads up to 300-lb has been designed for use with modular enclosures housing instruments and electronic controls. Engineered to be joined easily to any of the firm's equipment cabinets, the arm unit provides extra working, writing, and temporary storage space at convenient desk or counter levels. Used with individual cabinets or consoles, the extended arms can be positioned to provide work-writing surfaces within an arm's length of instruments, indicators, and electronic components in a research laboratory, communications center, or automation control facility. **Elgin Metalformers Corp., CE-6, 630 Congdon Ave., Elgin, Ill.**

Acid-Proof Treatment

AMAZITE, A PURE PLASTIC resin, may be applied right over new or old concrete, terrazzo, brick, stone, marble, slate, plaster, metal or wood to provide both complete protection against destructive acids and caustics, as well as rugged resistance to abrasion. Thick applications may be trowelled on to transform rough, pitted floors into smooth traffic areas, Surfaces in good condition may be protected and preserved by brushing on the treatment like a paint. Amazite hardens overnight into a dense, dustless, leather-tough film that does not chip even when "feathered." Under heavy traffic, ⅛-in. of the resin outwears 2-in. of concrete. **Hallemite Mfg. Co., CE-6, 2446 West 25th St., Cleveland 13, Ohio.**

EQUIPMENT MATERIALS and METHODS

(continued)

Fluorescent Highway Lighting

ACCORDING TO THE MANUFACTURER, the world's largest installation of fluorescent highway lighting luminaires is now providing vision-engineered illumination for nighttime users of the new Baltimore Harbor Tunnel. A total of 826 four-lamp, six-ft luminaires have been installed along the 16-mi of four-lane approach roadways leading to the city's new 1.7-mi tunnel that has eliminated the former highway bottleneck between New York and the South. Using the new tunnel route, travel time through Baltimore has been cut by as much as 34-min for motorists traveling via U.S. 301 between the North and the Glen Burnie-Annapolis area. From north to south via the tunnel and U.S. 1, travel time has been reduced by 18-min. Each of the four-lamp luminaires is equipped with two two-lamp ballasts. One ballast is connected to one 480-volt circuit, while the other is connected to a second 480-volt circuit. Each ballast supplies two ballasts located on opposite sides of the luminaire reflector. This arrangement provides the added advantages of lighting continuity at 50% capacity in case one of the two circuits fails. Roadway lighting units operate from a total of four 480-volt, three-phase, 60-cycle circuits—two on either side of the tunnel. Operating at full capacity, the lighting system provides a maintained illumination level of 0.6 foot-candle. **General Electric Company, CE-6, Schenectady 5, New York.**

Portable Transit Mix Plant

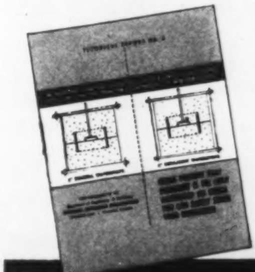
A PORTABLE TRANSIT MIX plant that has been standardized for quick delivery is now in production. Quickly disassembled into 9-ft maximum width sections, the Roustabout can be delivered to a different job site by truck. Easy, fast erection prevents costly production delays. Three aggregate compartments with a 38-cu yd total heaped capacity and one 60 barrel cement compartment are a part of the plant. Low height, plus wide top openings of the aggregate compartments offer easy charging by clamshell cranes. The bin shell is all-welded to simplify erection. Air for cement aeration, supplied by a built-in ¾-hp air compressor, is introduced through built-in fittings and plug-in connections. A manually operated high speed Concentric Batcher weighs cement on a scale separate from the aggregate scale. As a result, the plant owner can comply with rigid mix specifications. Cement is discharged within the aggregates for minimum dusting and maximum pre-mixing. **C. S. Johnson Co., CE-6, Champaign, Ill.**

What type should I specify?
What size should I specify?
Will it stop water?

NOW ...YOU CAN SOLVE YOUR WATERSTOP PROBLEMS IN A SCIENTIFIC MANNER

In the past, smooth surfaced waterstops have been used in concrete structures in the belief that they will effectively eliminate leakages resulting from water percolation around the waterstop. It has been a common practice to specify 6" waterstops for "small jobs" and 9" waterstops for "big jobs" . . . this practice was not based on the results of any scientific analysis. A series of tests have now been conducted by the Ontario Research Foundation in order to determine how the functional performance of DURAJOINT Waterstops, 4" and 6" wide, will compare to the functional performance of Dumbell Type Waterstops, 6" and 9" wide, when embedded in concrete and subjected to hydrostatic pressures of various magnitudes.

The tests provide positive proof that it takes the right combination of PVC material and multiple-ridge cross section design, found only in DURAJOINT, to stop water under all joint conditions that are likely to exist. The tests also proved that the 4" wide DURAJOINT Waterstop is far more effective than the 6" wide Dumbell Waterstop and the 6" DURAJOINT Waterstop is also far more effective than the 9" wide Dumbell Waterstop.



Be sure to investigate these interesting results yourself...send the coupon (below) today, for your free copy of the NEW DURAJOINT Technical Report No. 4. Contains complete technical data, graphic illustrations as to how the performances of waterstops compare, and actual copies of the test reports. If you are interested in waterstops, this report should prove to be one of the most interesting technical manuals you've ever read.

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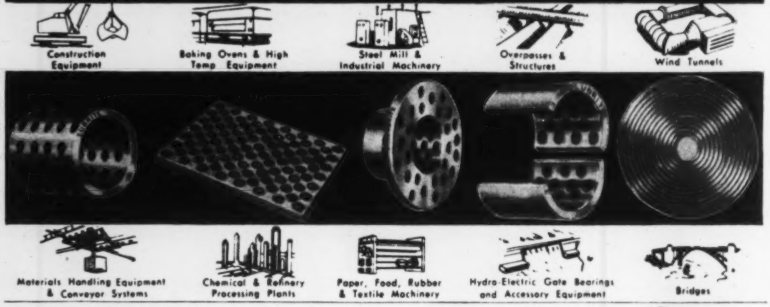
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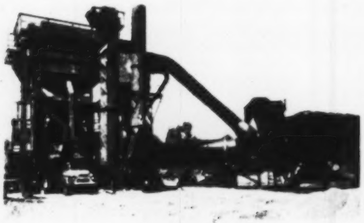
EQUIPMENT MATERIALS and METHODS

(continued)

Asphalt Plants

GREATER VERSATILITY AND INCREASED economy of operation result from new design features incorporated in the semi-portable and stationary asphalt plants. With the new design, mixers of 2, 2½ or 3-ton capacity can be installed in the same tower. Mixers of 1½-ton capacity are installed in a smaller tower unit. Only minor changes in mixer platform are required, whatever the mixer size. An exclusive feature of the mixers makes possible the easy replacement of liners, which are not riveted but bolted. Another cost-saving feature is the heavy-duty chain and sprocket drive located near the middle of the dryer. This roller chain drive rotates the dryer, minimizes torque on the dryer shell and, by eliminating the conventional ring gear, reduces the weight of the dryer by approximately three-quarters of a ton. **Bollard Asphalt Plant Div., The Colonial Iron Works Co., CE-6, 17643 St. Clair Ave., Cleveland 10, Ohio.**



Semi-Automatic

Hillbilly Core Drill

THE NEW HILLBILLY CORE Drill has been designed specifically for mineral prospecting. It is stripped to the bare essentials to save weight and expense. Its compact, lightweight design and extreme versatility find favor with construction engineers and others requiring reliable sub-soil information in rough terrain. Essentially, the drill consists of 3 basic components—power plant, planetary type drum hoist, and drill head, all compactly mounted on a tubular steel drag skid for maneuverability and ease of handling. Each component has its own separate clutch permitting the drill head to operate without the hoist, or vice versa. Or, when the rig is supplied with a built-in pump, it can be run or stopped at all times regardless of whether or not the drill head or the hoist is operating. **Acker Drill Co., Inc., CE-6, P.O. Box 830, Scranton, Pa.**

EQUIPMENT MATERIALS and METHODS

(continued)

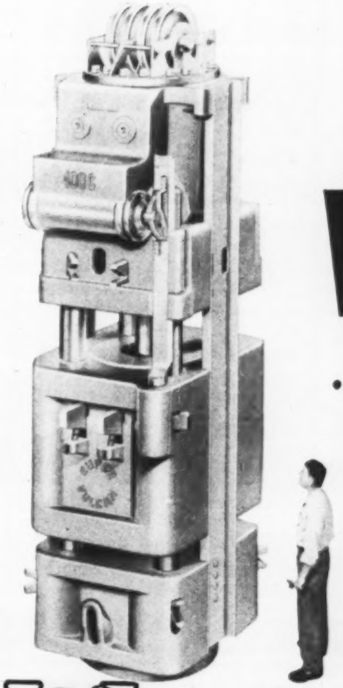
Bituminous Distributor

A REVOLUTIONARY NEW bituminous distributor called the "Thriftline" has been designed to do an economical job of heating and applying all types of bituminous material. Its "clean-cut" appearance is made possible by the rear housing which covers the pump, engine and all piping. This fog-proof, heated housing keeps all operating parts running at top efficiency. It also serves as a high operator platform, giving the operator 360-deg visibility, up out of the fog. Operation of the equipment is extremely simple. Two controls perform all functions: distribution, suck-back, hand spraying, filling, circulating and transferring. The new "easy flo" piping system, equipped with leakless valves, is only 5-ft in length. The company claims another "first" with its fire proof burner boxes. The burner boxes are completely enclosed, designed to snuff out the type of burner box fire that has always given distributor operators trouble in the past. **Municipal Supply Company, CE-6, South Bend, Ind.**

Simple Operation

Concrete Curing Membrane

CRETE-CURE, A WHITE pigmented concrete curing membrane having high dispersion characteristics has been developed. In explaining the advantages of this curing membrane, a spokesman for the firm stated that materials heretofore used in the manufacture of such membranes have had a tendency to settle, or separate. In Crete-Cure, the compounded particles of materials are dispersed, or given greater suspension. The result is a heat reflecting concrete curing agent that offers the maximum in moisture retention. **Thiem Products, Inc., CE-6, 9800 West Rogers St., Milwaukee 19, Wis.**



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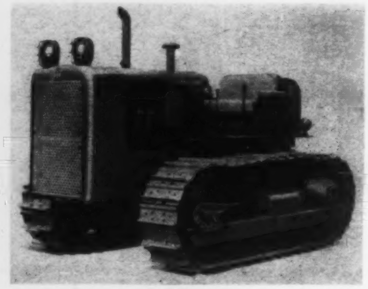
EQUIPMENT, MATERIALS and METHODS

(continued)

Diesel Crawler Tractor

A NEW 134-HP DIESEL crawler tractor has been introduced. The TD-20 offers a major advance in crawler tractor design in its power class with a six-speed full reverse transmission. With a single lever, an operator can shift the transmission through six speed ranges. A separate lever operates the forward-reverse "shuttle bar" control which provides six speed ranges forward and six in reverse. Because of this unique design, TD-20 operators can make full use of the high reverse speeds available because of the planned shift pattern. When the directional "shuttle bar" shift lever is moved the tractor travels either forward or reverse in any pre-selected speed range. As a consequence, dozing cycle time is rapidly reduced, since operators doze forward in second gear and return in third or fifth gear. This can be accomplished by the natural sweep shift hand motion of the tractor operator when changing direction of the tractor. **International Harvester Company, Construction Equipment Div., CE-6, 180 North Michigan Ave., Chicago 1, Ill.**



134-HP

Wheel Tractors

A NEW SERIES OF DW20 and DW21 wheel tractors, equipped with Super-Turbo engines which offer more power and greater operating efficiency, has been introduced. The new wheel tractors are designated the Cat DW21 (Series D) and DW20 (Series F), and their Super-Turbo engines have been designed to provide a maximum horsepower output of 320, accompanied by significantly improved torque rise characteristics. Operationally, these improvements combine to give these new machines the advantages of increased lugging ability and higher travel speeds. Of prime importance in the engines is the introduction of a new concept in diesel engine turbocharging. Caterpillar engineers have incorporated an improved air induction system, intended to improve on the normally high fuel-combustion efficiency and power output of turbocharged engines. Primarily, the air induction system of the Super-Turbo engine provides accurate control of Turbocharger speed over its complete range and delivers more air to the engine. By contrast, standard turbochargers operate at reduced RPM when the engine is working at below-maximum engine speed. **Caterpillar Tractor Co., CE-6, Peoria, Ill.**

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MANUAL 10 REVISED
CITY SURVEYING PROCEDURE
STANDARDIZED

In any community, large or small, boundaries of the original land subdivisions form the basis of all subsequent property subdivisions. Thus, the need for a complete and somewhat standard "city survey" is essential to the successful operation or expansion of any community. Recognizing this very important need, Manual 10 was originally written, and has now been revised, for the purpose of describing the various divisions of a city survey, to furnish specifications for it, and to make recommendations as to accepted technical procedures. The new Manual 10 contains revised chapters on such basic topics as Triangulation, Traversing, Leveling, Topography, and Property Surveying; a new chapter devoted to the ever-growing field of Photogrammetry; and a new Appendix containing the different types of maps used in city planning.

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EQUIPMENT MATERIALS and METHODS

(continued)

Plastic Waterstops

A CRITICAL PART OF THE design and construction of the Cambridge Electron Accelerator—an alternating gradient synchrotron which is a joint project of M.I.T. and Harvard University—is the use of specially fabricated soft ("60 Dura") vinyl plastic waterstops which surround the concrete pads on which magnetic accelerators rest. There are forty-eight 2-ft x 5-ft 8-in. concrete pads and sixteen 1-ft 6-in. x 1-ft 6-in. pads (Minimum 1-ft 6-in. thick) supported by steel "H" piles. These pads must not move more than a few thousandths of an inch for fear of disrupting the accelerating process. All the pads are below the ground water table and therefore subject to water infiltration. The pads, set independently in a common concrete floor are surrounded on four sides by a 1-in. expansion joint. Between this joint are the special Flextrip crimped waterstops, installed 10-in. above the bottom of the pads. The reason for the special waterstop design is that the waterstops must seal the pads against water seepage from below, and yet they must transmit the absolute minimum of stress to the pads that results from expansion and contraction of the surrounding concrete. In the expansion joint, above and below the waterstop, glass wool insulation is placed and sealed on the surface with an asphalt rubber sealer. Thus, each pad, with its magnetic accelerator, is protected against stress that would cause an adverse affect on the accelerating process. **Water Seals, Inc., CE-6, 9 South Clinton St., Chicago 6, Ill.**

Aluminum Railing

MORE THAN 10-MI OF maintenance free aluminum highway railing will protect motorists on Chicago's Calumet Skyway toll road, scheduled for completion early this year. The installation consists of 6-in. dia extruded tubing supported by a total of more than 6500 aluminum post castings suitably spaced along both sides of the roadway. According to the manufacturer, the railing and posts will never need painting. Total weight of rails and posts is over one-half million pounds. Installation is more economical than for other types of railing because the aluminum rails and fittings can be handled by two men without use of cranes or lift-trucks. The post castings are spaced on approximately 7½-ft centers and anchored with bolts to the parapet. Precision extrusion as well as casting assures ease of rail and post assembly and rigid support. **Aluminum Division of Michael Flynn Mfg. Co., CE-6, Philadelphia, Pa.**

ANOTHER PROBLEM SOLVED BY SPENCER, WHITE & PRENTIS

SHEETING, BRACING, UNDERPINNING used for foundation of one of Jacksonville's largest hotels

1. SOLDIER BEAMS, HORIZONTAL SHEETING AND BRACING
2. EXISTING BUILDING UNDERPINNED

Project: Robert Meyer Hotel, Jacksonville, Fla.
Architect: William B. Tabler, New York City
Engineers: Seelye, Stevenson, Value & Knecht, New York City
General Contractor: Daniel Construction Co., Jacksonville, Fla.

The site of this 19-story, half-block-square hotel in Jacksonville was nearly all sand. The foundation required several kinds of specialized work, which were awarded to Spencer, White & Prentis.

Soldier beams, horizontal sheeting and bracing (see photo) were used on 3 sides. This type of support made it unnecessary to cope with heavy hydrostatic pressure, since the openings between the sheeting permitted drainage during Florida's tropical storms.

Pit underpinning secured the J. C. Penney building, at right.

Whatever your foundation problem and wherever your job is located—whether South, North, East or West—Spencer, White & Prentis is equipped to give complete dependable service.

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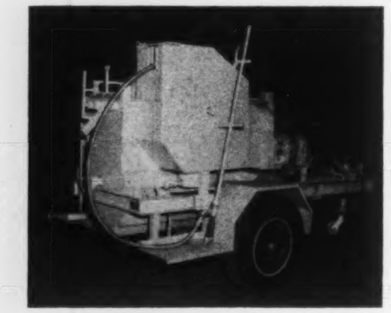
Melter-Applicator

THE MODEL BMA-40 Combination Melter-Applicator offers for the first time a practical, safe, and economical method of melting and applying rubberized joint sealer, using only one piece of equipment. It is a mobile, high performance melter combined with an applicator nozzle attached to a patented, flexible hose that can be reeled in and stored in a heated compartment. The melted material is pumped under pressure to the joint, and the entire pump, piping, hose and nozzle are heated by a simple, convenient arrangement that utilizes the waste heat from the burner to eliminate the inconvenience and unnecessary cost of flushing the system with a solvent at the end of the day, or using hand torches to thaw out frozen lines. Other features of the machine are: bottle gas burner with thermostatic control, assures proper temperature without overheating; low silhouette melting chamber makes for ease of charging; melter combines very high melting rate with low volume of material; and melting chamber completely accessible for cleaning. **Berry Corp., CE-6, Stone Road, Lexington, Ky.**



Safe & Economical

Anchor Bolt Fitting

NOT ONLY WILL THE NEW anchor bolt fitting completely eliminate the protruding anchor bolt that has long been a traffic hazard in new plant construction, but it will also eliminate the costly and time consuming errors so often found in the initial setting of anchor bolts when concrete is being poured. The Deco Anchor is flush with the floor until the actual installation of equipment or column is made. The box-like fitting, attached to the top of the anchor bolt contains an oblong nut, movable in all directions sufficiently to compensate for the usual error in setting anchor bolts. The machine or column is attached to the fitting by use of a stud of the desired length, thus eliminating the hoisting and lowering of machines over a fixed bolt by the trial and error method. The fitting is cast from high strength malleable iron, which has a strength ratio of approximately 2 to 1 over that of the size bolt for which it is designed. A temporary washer is centered in the flush area of the casting to protect the movable nut during the pouring of concrete. The anchor bolt is centered in the fitting when attaching to setting templates, and is no more difficult to install than conventional type anchor bolts. The large flat surface of the casting provides an ideal arrangement for leveling and doweling where it is necessary. Because the stud for attaching the machine is removable, too much or too little projection above the floor is eliminated. **Decatur Engineering Co., Dept. C., CE-6, 519 East William St., Decatur, Ill.**

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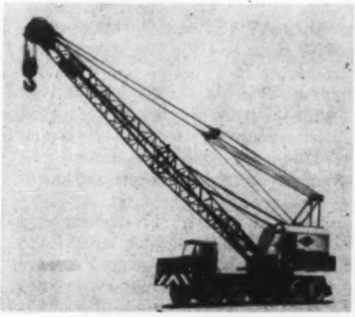
EQUIPMENT MATERIALS and METHODS

(continued)

4 Axle Truck Crane

A NEW 70-TON CAPACITY four axle truck crane has been developed. Designated the Type 84-T, it is available in 8 x 4 and 8 x 6 carrier drives. Noteworthy in the crane carrier is the exclusive use of high strength T-1 steel in the main frame and frame components. The frame consists of two full box section main members, joined by seven cross members, resulting in high strength and rigidity at reduced weight. Special features include easily removable "pin-on" type front and rear outrigger boxes, roller mounted outrigger beams, full length combination deck-fender design, large full vision operator's cab and full frame width engine compartment. Hydraulic steering and 20 ply-14:00 x 24 tires are standard equipment. **Baldwin Lima-Hamilton Corp., Construction Equipment Division, CE-6, Lima, Ohio.**



70-Ton Capacity

New Shovel

FEATURES OF THE NEW SHOVEL include up to 100-yd per hour production, a 15-ft 2-in. dumping height, and a maximum dumping radius of over 20-ft. New wider-design, twin-boom construction provides greater rigidity and strength for maximum performance on all digging and stockpiling operations. The special ½-yd rehandling bucket is available for handling stockpiled materials in gravel and sand pits, plant yards or other aggregate yards. This ½-yd rehandling bucket is quickly interchangeable with the ⅜-yd digging bucket. The shovel attachment is also interchangeable with the company's entire model line, including the crane-carrier mounted model T-35, crawler-mounted model C-35 and the self-propelled model CR-35. **Schield Bantam Company, CE-6, Waverly, Iowa.**

Today's Modern Water Tanks Prestressed Concrete Type

Long and Short Term Economies Making Them Popular

A modern prestressed concrete tank is not only economical in first cost, but because of its almost maintenance free character, offers any municipality real long term economy. Any tankage engineering study should include calculated maintenance costs over the estimated life of the facility. Average yearly maintenance on a 3,000,000 gallon steel tank is estimated at $2500 per year at current prices. For a prestressed concrete tank, maintenance is negligible; however, occasional painting for color effect may be desired.

When the charges for servicing the initial cost plus relative maintenance allowances are plotted, the prestressed concrete tank will often show a lower out of pocket cost to the owner in less than 5 years. When these costs and their increases are extended for an expected service life of 50 years, the savings to the owner with prestressed concrete are enormous.

The prestressed concrete tank is also a good looking tank . . . it is inherently strong and extremely stable . . . it is designed and built for permanence. And, 75% of the contract price is spent right in your local community . . . construction is done with materials and labor available locally.

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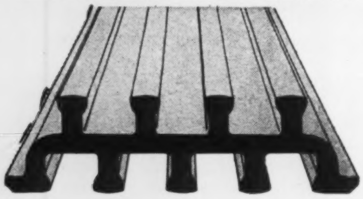
LABYRINTH WATERSTOPS

A SOUND INVESTMENT FOR CONCRETE CONSTRUCTION!



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2. Then consider how important safe, secure *watertight* concrete joints are.

3. Thorough watertightness *can* be secured by installing Labyrinth Waterstops—a dividend that makes the low initial cost of the product insignificant when compared to your total investment—and one that insures watertight concrete joints for years!

- Corrugated ribs grip concrete, insure an everlasting bond between joints.
- Finest polyvinyl plastic resists chemical action, aging, severe weather.
- Takes just seconds to nail to form . . . easy to cut and splice on location (prefabricated fittings available).
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EQUIPMENT MATERIALS and METHODS

(continued)

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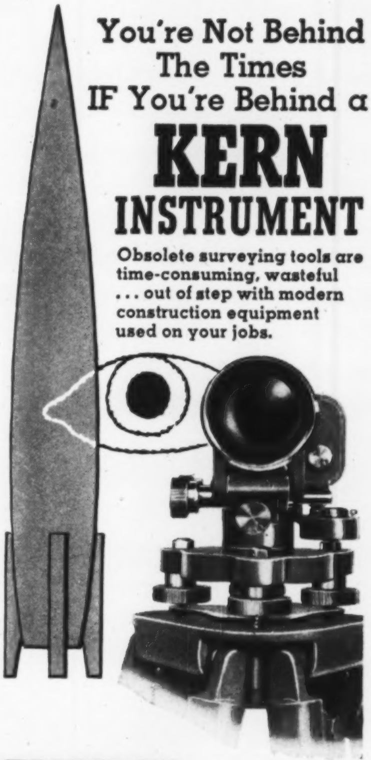
Palos Verdes Estate, exclusive residential area on the peninsula west of Los Angeles Harbor, is the site of two newly constructed water reservoirs. These are not ordinary water tanks. The smaller of the two has a capacity of 3-million gallons. Yet, the walls are only 7-in. thick. This is possible because individual wall sections are poured directly on top of a ring of Gates Rubber Stripping. Then all the sections of wall are pulled inward by the new method of prestressing—horizontally wrapping over 120-mi of steel wire around the reservoir under a pressure of thousands of pounds per sq in. The stripping allows this inward movement. Prestressing is a method of adding sufficient strength to the walls to insure an adequate inward resistance to the tremendous outward force which will be exerted against the walls when the reservoir is full of water. Prior to pouring the walls, Gates Waterstop (a specially designed rubber seal) is partially inserted along one vertical edge of each section. It is also partly buried in the base footing, leaving the remainder to be sealed in the walls. Even though invisible, these products will last the life of the reservoir. **The Gates Rubber Co., CE-6, 999 S. Broadway, Denver, Colo.**

"Pipeliner" Rock Ripper

Designed especially for ripping ahead of pipeline trenches, a "pipeliner" model of the tractor-mounted rock rippers is now in production. The hydraulically-operated heavy duty tool beam carries a single ripper shank in a swing bracket. The shank can thus "trail" the tractor for easy steering even when ripping at maximum depth. The free-swinging bracket also lets the replaceable ripper point "hunt" to seek out weak spots in the rock. The "pipeliner" rippers are available in two styles; as an attachment for present rock rippers, or as a complete "pipeliner" ripper assembly. The attachment unit will take 24-in. or 48-in. shanks (straight or curved). The ripper will take shanks to 72-in. ripping depth, and is equipped with pusher plate for tandem operation with a booster tractor. Both types are available for all popular heavy-duty crawler tractors, and operate successfully in rock, hardpan, caliche, cemented gravel and other hard-to-dig materials. **American Tractor Equipment Corp., CE-6, 9131 San Leandro Blvd., Oakland 3, Calif.**



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Literature Available

House Organ—Several articles on the use of track-type tractors are included in Volume 19, No. 4 issue of the magazine "Production Road." A general interest feature story on American agricultural progress for the past 100 years coincides with a two-page story on the recently announced J. I. Case torque converter equipped rubber-tired tractors. These tractors feature a new type drive called Case-O-Matic, which includes Twin Disc Single-Stage Torque Converter and Friction Clutch components. Other stories cover manufacturing, logging and mining, plus a technical article on the use of output shaft governors as applied to torque converters. **Twin Disc Clutch Company, CE-6, Racine, Wis.**

Compaction Methods & Equipment—To help bring some of the current problems of modern day compaction methods and equipment into focus, this 49-page manual presents some recently published articles on specific compaction problems and equipment applications. Also, a glossary of some of the most commonly used compaction terms and their meanings has been included for possible reference by the reader. **Bros, Inc., Road Machinery Division, CE-6, 1057 Tenth Ave., S.E., Minneapolis 14, Minn.**

Transits & Levels—Bulletin 100-PI describes in detail the transits and levels now available to the American surveyor, contractor and builder. Although built in Japan by Path Engineering Instruments, they were designed by Americans who have close supervision over their manufacture. Among the instruments included are a 6-in. "T" transit (1-min, 20-sec) with carrying case and tripod; a 5-in. "T" transit (1-min) with carrying case and tripod; a tilting level; a transit level, and a pocket transit. **Precision Instruments Inc., CE-6, 1900 Fifth Ave., Troy, N. Y.**

Use of Stone—A colorful brochure called "The Modern Stone Age Is Here" reviews pictorially the use of stone through the ages from the time of the cave man, the Egyptian, Grecian, Roman, Byzantine, Medieval, Renaissance Periods, the present time, and closing with a large 22-in. x 32-in. panorama of the City of the Future. It is of value to the architect, builder, and property owner for its many suggestive uses of stones and stone patterns for all types of construction. **Building Stone Institute, CE-6, 420 Lexington Ave., New York 17, N. Y.**

Highway Test Apparatus—A new 51-page catalog (No. 10) of apparatus for testing soils, cement, concrete, asphalt, aggregates and general laboratory apparatus, including balances, ovens and general laboratory items, has been published. **Hogentogler & Co., CE-6, 5218 River Road, Washington 16, D. C.**

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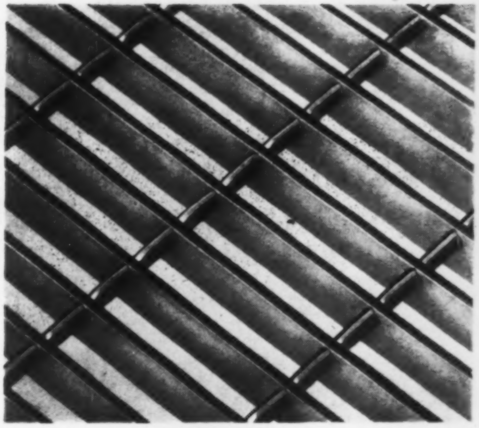

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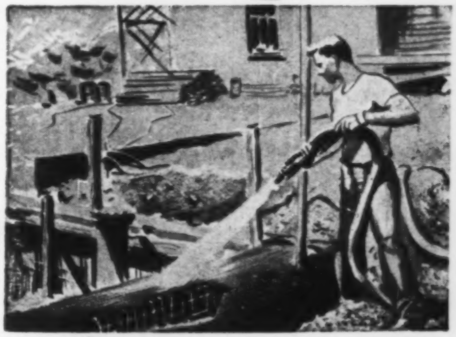

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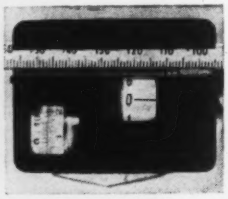

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Films Available

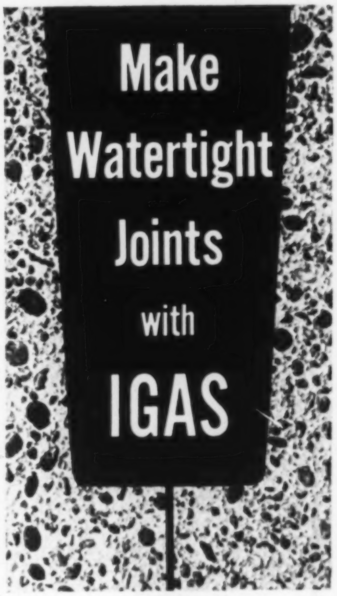
"Memo To The Winning Contractor . . . Why Twins?—This new 16mm color movie, featuring the operation of Euclid's Twin-Power 24-yd struck capacity TS-24 Scraper, points up the decided trend to twin powered units for many kinds of earthmoving jobs. In interesting "show me" fashion, the film spells out where, how and when twin power can be put to work advantageously. **Euclid Div., General Motors Corp., CE-6, Cleveland 17, Ohio.**

"The Constructors"—This 17-min, 16-mm color film has been basically designed to interest students of junior and senior high school age in engineering, while they are young enough to take the proper preparatory courses. The film has the same type of compelling interest that draws spectators to construction sites. It opens with a blasting scene and features such fascinating activities as swinging sections of high bridges into place, boring tunnels through mountains, clearing forests, and catching hot rivets on towering steel beams. **The Associated General Contractors of America, Inc., CE-6, Munsey Building, Washington 4, D. C.**

"Roof Decks Unlimited—With Perlite"—A new 20-min, 16mm color sound movie on the design and construction of perlite concrete roof decks has just been produced. It is available without charge for showings before architects, contractors, engineers, builders, and other interested groups in the building industry. Featuring outstanding examples of perlite concrete roof decks in contemporary architecture, the motion picture provides dramatic illustration of perlite concrete's high fire resistance, its excellent insulation value and its design flexibility. **Perlite Institute, CE-6, 45 West 45th St., New York 36, N. Y.**

"Bonus Loads"—This 16mm, 22-min color-sound movie highlights the design and operating features of the "Michigan" line of tractor scrapers. The 10½-cu yd-heaped Model 110, the 18-yd Model 210 and the 27-yd Model 310 are seen working on actual job sites. The motion picture shows how "bonus loads" are picked up quickly and easily in virtually any kind of terrain—rock-hard gypsum, ball-bearing sand, sand clays, silts and topsoils. **Clark Equipment Company, Construction Machinery Division, CE-6, Pipestone Road, Benton Harbor, Mich.**

New Films—Some of the many motion pictures available are "The Gamblers," which points out the importance of safety on heavy construction work; "Downtime," which discusses the general preventive maintenance of small engines; and "The Big Track," which tells of the fifty-year growth and historical background of the crawler tractor. **Caterpillar Tractor Co., CE-6, Peoria 8, Ill.**



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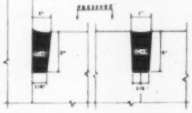

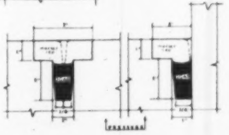

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From the
MANUFACTURERS

CELEBRATES 40TH ANNIVERSARY: This is an anniversary year for the Bausch & Lomb Optical Co. of Rochester, N. Y. It marks 40 years of the successful manufacture of high grade optical glass for scientific, professional and industrial purposes . . . **DEPENDS ON SMALL BUSINESS:** Emphasizing its dependence on small business, the DuPont Co. has reported that it bought $860 million worth of materials and services last year from more than 30,000 different suppliers, most of them small concerns. Most of this—over $710 million—was spent for a wide variety of chemicals, supplies, and basic materials and services needed to manufacture the company's products . . . **CONSTRUCTION COSTS:** M. Clare Miller, a representative of The Associated General Contractors of America and president of the San Ore Construction Co., McPherson, Kansas, said that in the last year highway construction costs rose 1.9%, while cost of construction machinery rose almost 8%, steel and cement costs rose about 6%, and labor wage rates increased about 4.5% . . . **GETS CERTIFICATE:** A Certificate of Merit, the Navy's highest award to civilian organizations, has been presented to Caterpillar Tractor Co. It was awarded for outstanding service to the Department of the Navy in development, manufacture and production of specialized tractors for Operation "Deep Freeze 1", an exploration and construction mission in the Antarctic . . . **NAME CHANGE:** One of America's large diversified chemical companies doing business since 1920 as Allied Chemical & Dye Corp. has become simply Allied Chemical Corp. The Board of Directors feel that not only will the new name show the broad nature of the Company's position in the chemical industry, but the shorter name will be better adapted to identify the Company in its public and trade relations . . . **NEW QUARTERS:** Stanco Mfgs. & Sales Co., formerly located at 1931 Pontius Ave., West Los Angeles, have moved into completely remodeled quarters at 1666 Ninth St., Santa Monica, Calif., Southwestern Engineering Co. has moved its Separator Div. into new and expanded plant facilities at 4501 Santa Fe Ave., Los Angeles, Calif. . . . **SALES REPORTED:** Vulcan Materials Co., Birmingham, Ala., which on December 31, 1957, acquired by merger Union Chemical & Materials Corp., and Lambert Bros., Inc., and, by acquisition of capital shares, several other companies, reports for 1957 consolidated sales of $90,602,000 and consolidated net income after taxes of $5,778,000 . . . **APPOINTMENTS:** Robert M. Cox has been assigned to the Trane New York office as sales engineer . . . The election of Edward Brause as vice president for public relations of the Merritt-Chapman & Scott Corp. has been announced.

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Figure B-175. Type M-R Gates designed especially for application to centrifugal pump discharge lines. A rubber seating ring is inserted in the seat to absorb the slap which occurs when pumps stop. A flexible bar connection is arranged between the hinge links to provide a stop for the gate shutter to prevent the outer edge of the shutter from tipping downwardly when flow abruptly ceases. Smaller sizes of gate are provided with a bumper arrangement to prevent the shutter being forced too widely open when flow starts.

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PROCEEDINGS AVAILABLE

For instructions and key to abbreviations, see next page. Each member is entitled to 100 different "Proceedings Papers" yearly, ordered from these pages, plus all papers of the Technical Divisions in which he registers. The latter papers will be mailed automatically. Discussion of a paper will be received during the four full months following the month of issue.

May

1621. Connecticut Highways and the 1955 Floods, by Newman E. Argraves. (HW) Details of emergency and long-term restoration of the structures and road locations damaged or destroyed by the 1955 floods are presented in this paper.

1622. The Role of the State in the Highway Program, by Rex M. Whitton. (HW) This paper presents the functions of the state in carrying out the expanded federal aid highway program. Program planning, location and plan development, supervision of construction, and maintenance of the system are examined in relation to the state.

1623. Ground Transportation at New York International Airport, by Richard I. Strickland. (HW) A new concept in airport terminals resulted in a 655-acre "Terminal City" which will include 10 passenger terminal buildings, 10 miles of two-lane roads, and multiple parking facilities. Basic planning data and design of the roadway system are presented.

1624. Application of Interstate Highway Design Standards, by J. C. Young. (HW) Minimum design standards set up to govern design and construction of the Interstate Highway System are examined, with reference to their applications.

1625. Continuous Origin and Destination Traffic Surveys, by S. T. Hitchcock. (HW) A system of collecting origin and destination information on a continuing basis using a permanent staff and statistical methods already adopted in continuous traffic counting programs would provide reliable information with technique improvement and possible reduction on costs.

1626. Quality Control for Large Highway Projects, by E. A. Abdun-Nur. (HW) This paper describes an approach to quality control dictated by factors inherent in large-scale accelerated programs, and stresses application of control to materials and construction operations.

1627. Correlation of Geometric Design and Directional Signing, by George M. Webb. (HW) Directional signing must be given consideration during the earliest planning and design stages. This requires that engineers be fully cognizant of each other's problems. This paper examines these factors and presents certain basic principles for guidance of all concerned.

1628. Integrated Planning of Highways and City Streets, by Guy Kelcey and George Leland. (HW) The paper illustrates integrated planning of a system of arterial highways and city streets in a metropolitan region, with aspects of development assuring future growth and economic well-being of the region considered.

1629. The Location of Maximum Principal Stresses, by T. Ranov and H. S. Wolko. (ST) Principal normal and shearing stresses in transversely loaded beams have extrema between neutral axis and most distant fiber when the "load-section" parameter M/Vk has values between certain limits which depend on the geometry of the cross section. These limits are presented for rectangular sections and for commonly used I-beam profiles.

1630. The New Art of Fabrication Engineering, by Frederick H. McDonald. (ST) Fabrication engineering is presented as a new subject in education and for the control of design in practice. It is defined as the art of determining the materials, methods and places of assembly to assure maximum use and competitive values for the products of engineering design.

1631. Moments in Continuous Beams on Flexible Supports, by Robert A. Williamson. (ST) A procedure is given for determining end moments in continuous beams on elastically deflecting supports by balancing the angle changes resulting from introducing imaginary hinges at supports. Moments are obtained by successive corrections re-establishing continuity. Application is illustrated by a numerical example.

1632. Design Features of Lower Deck of George Washington Bridge, by Irvine P. Gould. (ST) The addition of a lower deck for the George Washington Bridge follows the concepts of the original designers. The bridge expansion will take place without exceeding the contemplated design loads. The approaches must be modified and built with minimum interference to the 36,000,000 vehicles using the bridge annually.

1633. Report of Committee on Deflection Limitations of Bridges. (ST) This paper reviews the history and purpose of limitations on span-depth ratio and deflection-span ratio of the AASHO Specifications for Highway Bridges. Dynamics of bridge vibration from both the structural and psychological point of view are examined.

1634. Rigid Frame Analysis with the Aid of Digital Computers, by E. Czerniak. (ST) This paper shows how rigid frame type structures may be analyzed through existing general purpose mathematical programs. Examples including a multibay gabled bent and lean-to frames with tapered girders demonstrate the simplicity of the method. Effects of foundation settlement, shrinkage, and temperature changes are included.

1635. Ultimate Strength Analysis of Long Restrained Reinforced Concrete Columns, by Bengt Broms and I. M. Viest. (ST) Theoretical analyses, based on idealized stress-strain diagrams for concrete and steel, are presented for the strength of slender concentrically and eccentrically loaded columns restrained at both ends. The effects of end restraints, of the increase of eccentricity caused by deflections and of buckling are taken into account.

1636. Use of Modern Computers in Structural Analysis, by Ray W. Clough. (ST) The paper reviews considerations involved in performing structural analyses by electronic digital computers. A scheme for handling calculations by a series of matrix operations is given, and a bibliography on matrix and computer analyses of structures is included.

1637. Specifications for Preservative Treatment of Timber: Progress Report of a Sub-Committee of the Committee on Timber Structures. (ST) The purpose of this report is to provide recommendations for the application of various types of preservative in addition to brief descriptions of the preservatives currently in common usage.

1638. Lateral Load Analysis of Two-Column Bents, by John E. Goldberg. (ST) Simple equations involving only joint rotations are presented for symmetrical two-column bents subjected to lateral loads. Iterative, algebraic and composite solutions are demonstrated.

1639. Waterfront Structure Design for Varying Conditions, by W. C. Stevens and J. S. Wilson. (WW) A review of the different designs of pier and wharf structures constructed by the Port of New York Authority during the past ten years is presented. Effects of site conditions and functional requirements on each of six major projects are examined and resulting construction described.

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1640. Wave Run-Up on Roughened and Permeable Slopes, by Rudolph P. Savage. (WW) Laboratory tests determining run-up on various beach slopes as a result of wave action are described. Curves relating the run-up to wave steepness, slope roughness, and slope permeability are presented.

1641. Railroad Bridge Alterations, Calumet-Sag Project, by George W. Svoboda. (WW) The widening of the Calumet-Sag project waterway requires the alteration of numerous railroad bridges whose expense is shared by bridge owners and the federal government. Problems from the standpoint of cost apportionment, planning, and negotiation of construction agreements with bridge owners are detailed and complex.

1642. Calumet River Lock, Calumet-Sag Project, Illinois, by W. J. Santina and E. G. Hoffmann. (WW) This new navigation lock will involve departures from usual design in that lock walls and guide walls will be of steel sheet piling construction, with concrete construction being limited to gate blocks. Lock gates will be of the sector type, with a total span of 110 feet.

1643. Calumet-Sag Navigation Project, by John B. W. Corey. (WW) A serious obstacle to navigation on the Illinois Waterway will be removed when improvements to the Calumet-Sag Channel have been completed. Barge tows four times larger than present will then be able to connect with deep-draft navigation at Lake Calumet.

1644. Stability of Coastal Inlets, by Per Bruun and F. Gerritsen. (WW) Existing theories of the relationship between tidal range, tidal prism, and inlet cross section are reviewed and compared. Data on inlets and the effect of the quantity and type of littoral material on inlet action are examined.

1645. Increased Resistance to Deformation of Clay Caused by Repeated Loading, by H. B. Seed, R. L. McNeill and J. de Guenin. (SM) The influence of stress history in the form of a series of repeated stress applications, in increasing the resistance to deformation of compacted specimens of silty clay is described. The significance of results in assessing the design life of highway pavements is reviewed.

1646. Geology and Soils of the Newark (N. J.) Metropolitan Area, by Alfreds R. Jumikis. (SM) This paper examines major soil types encountered in the glaciated Newark area, presents physical properties of the glacial soils, and indicates the practical applications of engineering soil maps.

1647. Development of Multiple-Wheel CBR Design Criteria, by C. R. Foster and R. G. Ahlvin. (SM) This paper presents an improved method for developing multiple-wheel CBR design criteria from proven single-wheel criteria. The development of the method and its applications are illustrated.

1648. Symposium on Geological Factors in Tunnel Construction: Tools and Techniques, by Arthur B. Cleaves. (SM) Types of geological investigations essential to delineating potential tunnel problems, and new core boring aids are described.

1649. Symposium on Geological Factors in Tunnel Construction: Geology and Tunnel Design, by A. B. Reeves. (SM) The geologist-engineer relationship in tunnel design and construction is outlined. Methods of investigation, selection of tunnel location, and factors to be considered in the preparation of designs and specifications for tunnels are examined.

1650. Symposium on Geological Factors in Tunnel Construction: Geophysical Investigations for the Lehigh Tunnel, by H. LeRoy Scharon and Arthur B. Cleaves. (SM) This paper describes investigations conducted in the portal areas of the Lehigh Tunnel on the Pennsylvania Turnpike System which were made for the purpose of indicating the approximate depths to solid bedrock.

1651. A New Rubberized Asphalt for Roads, by J. York Welborn and John F. Babashak, Jr. (HW) This paper shows that the addition of minute quantities of sulfur to natural rubber latex during blending greatly improves the properties of rubberized asphalt. Asphalt prepared by this method should reflect in improved performance when used for surface treatment.

1652. Discussion of Proceedings Paper 1250, 1374, 1380, 1385, 1525, 1625. (HW) Scott H. Lathrop and Francis J. Farias closure to 1250. Charles E. De Leuw, Karl Moskowitz on 1374. Paul L. Nichols on 1380. José A. J. Salas and V. Escario on 1385. G. D. Love on 1525. J C Carpenter on 1625.

1653. Discussion of Proceedings Paper 1211, 1514. (WW) J. W. Johnson closure to 1211. Roy F. Bessey on 1514.

1654. The Structure of Compacted Clay, by T. W. Lambe. (SM) This paper describes the nature of clay structure, a term referring to the arrangement of particles and the electrical forces acting between them. The effects of forces and environmental factors on structure are inferred from the principles of colloid chemistry and crystal chemistry.

1655. The Engineering Behavior of Compacted Clay, by T. W. Lambe. (SM) This paper employs the principles of colloid chemistry and crystal chemistry to give a physical explanation of the engineering behavior of compacted clay. The relationship between clay structure and behavior is described and illustrated with experimental data.

1656. Discussion of Proceedings Paper 1057, 1100, 1233, 1234, 1254, 1255, 1312, 1315, 1354, 1356, 1433, 1434, 1436, 1437, 1519, 1560, 1561, 1565. (ST) Alfred L. Parme closure to 1057. No closure notice to 1100. E. Neil W. Lane corrections to discussion, T. F. Hickerson closure to 1233. Guillermo Villena closure to 1234. Jack R. Benjamin and Harry A. Williams closure to 1254. Ardis White and William B. Purnell closure to 1255. J. M. Pickett closure to 1312. T. Y. Lin closure to 1315. E. Neil W. Lane on 1354. Kuang-Han Chu corrections to discussion, I. M. Nelidov on 1356. John Steinbrugge on 1433. F. J. Tamanini, Howard H. Mullins, R. E. Bowles, Robert B. Harris, Albert D. M. Lewis on 1434. James I. Rooney, A. A. Eremin on 1436. A. S. Hall, Alan M. C. Holmes corrections, Victor R. Bergman on 1437. A. W. Coutris, T. Y. Lin on 1519. George D. Siegfried on 1560. William Zuk on 1561. Kuang-Han Chu corrections to 1565.

1657. Discussion of Proceedings Paper 941, 1160, 1204, 1205, 1299, 1301, 1427, 1428, 1429, 1439, 1537, 1545. (SM) Ray W. Clough and David Pirtz closure to 941. Eben Vey closure to 1160. Milos Polivka, Leslie P. Witte, and John P. Gnaedinger closure to 1204. Jack W. Hilf closure to 1205. No closure notice to 1299. S. J. Johnson on 1301. F. E. Richart, Jr. closure to 1301. D. P. Krynine on 1427. Jacques de Medina, F. L. D. Wooltorton, S. F. Gizienski on 1428. John A. Trantina on 1429. A. A. Eremin on 1439. D. C. Pearce on 1537. Robert W. Cunny on 1545.

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Third tube of Lincoln Tunnel, under the Hudson River. Owner and Engineer: The Port of New York Authority. General Contractor: Joint Venture—Mason, Johnson and MacLean, New York City. Pozzolith Ready-Mix concrete produced by Hudson Builders Material, Inc., Jersey City, N. J.

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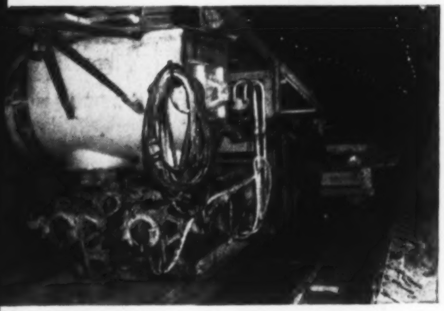
92

Ready-mix truck on top side of tunnel discharges concrete into "elephant trunk" . . .

Concrete goes down "elephant trunk" to buggies in tunnel . . .



Concrete pump receives concrete from buggies and pumps it into tunnel lining forms.

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